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THE PROBLEM OF THE TONAL DIP.*

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Routine tests of hearing often reveal striking depressions of sensitivity at some one place in the frequency scale. These local depressions of sensitivity have long been known, and in earlier discussions were referred to as "tonal gaps," since it was thought that within the region in question the loss of acuity was complete. Recent studies, however, in which relatively strong sources of sound have been employed, invariably have shown that the loss is only relative; the "gap" is filled in if tones are presented at sufficient intensities.^{1,12} Hence, "tonal dip" is now preferred as a more appropriate term.

Slight variations of sensitivity are found throughout the frequency scale, but large local depressions are most often disclosed in the medium high frequencies. In the limited series of tones ordinarily used in audiometer tests, the tone of 4,096 cycles is the one that shows the most frequent and marked depressions. It is uncertain whether the inclusion of this tone in the conventional series of test tones is a happy accident, or whether some other tone in the same region of the scale would reveal more striking variations. According to Fowler's studies,¹¹ in which over 1,000 ears were tested at short intervals of frequency, tonal dips occur most often between 1,000 and 5,000 cycles, and especially between 3,000 and 4,000 cycles. The losses usually extend over one and one-half to two octaves; the narrowest dip encountered was about five-sixths of an octave.

*From the Otological Research Laboratory, Johns Hopkins University. To Dr. S. J. Crowe and Dr. S. R. Guild the author expresses his deep indebtedness.

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The tonal dip is a sex-related characteristic; it is fairly common in males but comparatively rare in females. Ciocco in 1932,⁵ from a study of 1,980 persons, gave the percentages of cases of 4,096 cycle dips for six age groups and showed that the percentages increased progressively from 10.5 for males and 0 for females in the youngest group (0-19 years), to 59 for males and 26.6 for females in the oldest group (60-69 years). Dips at other frequencies also were more common in males than in females.

METHOD AND PROCEDURE.

The present study was made in the effort to discover the anatomical conditions underlying the tonal dip. It consisted of an examination of serial sections of temporal bones of persons whose hearing had been tested before death and who thus were known to have suffered a tonal dip. For the general procedure of testing and the method of histological treatment the reader is referred to previous publications from this laboratory, particularly the report by Crowe, Guild and Polvogt on the pathology of high-tone deafness.⁷

The material for this study was selected after examination of the audiograms of all the ears for which serial sections were available, about 1,050 in all. Four groups, including 73 ears, were studied in detail.

Group I, a control group, consisted of 16 ears in which all tones, at least up to 8,192 cycles, were within normal limits of acuity. Half of these ears were from males and half from females.

According to the convention of this laboratory, hearing is regarded as within normal limits even if the curve falls to 20 decibels below the zero line of the standard audiogram; this definition takes into account the conditions of testing, which are often disadvantageous. Frequently the patient is seriously ill and must be tested in the ward, where disturbing noise is unavoidable. The audiogram is judged somewhat by its general course, and a drop to 25 decibels below the zero line for a single tone is acceptable for the normal class. The acuity for tones above 8,192 cycles was not considered in the classification, partly because in many instances no tests were made above this point, and partly because under the condi-

tions, which include the factor of age, normal hearing for the higher tones is not common.

A second group of 15 normal ears, which also will serve as controls for this study, is found in the report of Crowe, Guild and Polvogt;⁷ further data on this same group have recently been reported by Oda.¹⁹

Group II, the main experimental group, included 34 ears in which the audiograms revealed the presence of a simple tonal dip. By a simple dip is meant a local depression of sensitivity in an audiogram which is otherwise within normal limits. To be regarded as significant, it was required that the depression extend at least 15 decb. below neighboring tones, and at least 30 decb. below the zero line of the audiometer curve.

It should be noted that this criterion is more rigid than that outlined by Guild¹⁴ and used by Ciocco⁵ in the study already described, in which a tonal dip was taken as a local depression of more than 10 decb. below the zone in which most of the audiogram fell, regardless of whether the zone was within normal limits.

The more rigorous criterion was used with the object of eliminating the complicating features of pathology from causes that might have no relation to the dip itself.

The magnitude of the dips varied greatly. One of the smallest included in this group is shown in Fig. 1 in the audiogram for ear No. 23. The depression at 512 cycles does not meet the criterion, while that for 4,096 cycles barely does so. The largest dip in the group extended to 75 decb. below the zero line at 4,096 cycles, and is shown in the audiogram of ear No. 54 in Fig. 1.

Of the 34 simple dips studied, 32 were at 4,096 cycles, one at 2,048 cycles, and one at 5,793 cycles. All of these were in males except that at 5,793 cycles.

Group III consisted of 19 ears which showed a marked local depression but which did not meet the criterion of normal for other tones. Often the general course of the audiogram was 25 or 30 decb. below the normal line. In other instances a number of tones were included in the depression, especially the high tones. In most of these cases there was only a partial return to normal above 4,096 cycles; but it was

required that the return amount at least to 20 deb. Cases in which there was no such return toward normal fall into the classification of high-tone loss and were considered by Crowe, Guild and Polvogt in the study already mentioned. In this group of 19 ears, 18 had their lowest measured points at 4,096 cycles, and one at 5,793 cycles; 17 were in males and the remaining two represented the right and left ears of a woman, age 65 years. The deepest, from a man, age 28 years, is shown in the audiogram for ear No. 73 in Fig. 1.

Group IV was made up of four ears of "borderline" cases. These cases do not meet the criterion of 30 deb. below the

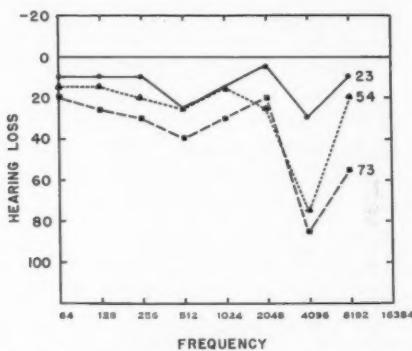


Fig. 1. Sample audiograms. Hearing loss is given in deb. with respect to the normal (zero) line. The solid-lined curve is for ear No. 23, the left ear of a man, age 60 years; the dip at 4,096 cycles barely meets the criterion used. The dotted line is for ear No. 54, the left ear of a man, age 42 years; this dip is the deepest found which was limited to one tone. The dashed line is for ear No. 73, the right ear of a man, age 28 years; the dip at 4,096 cy les is profound, but acuity in general is depressed, and the return at 8,192 cycles is but partial.

zero line, and may be called dips only by virtue of the fact that one tone falls considerably below the neighboring tones for which the acuity is unusually high. Of these, three were in females and one in a male. Other borderline cases were found, as well as cases which barely met the criterion, but are not included in this report because they did not differ in any significant way from the examples given.

The method of treatment of this material was that described by Crowe, Guild and Polvogt.⁷ A tracer series of serial sections, consisting of every tenth section, was used to map the state of the organ of Corti, the nerve fibres contained

in the channel below the limbus, the external sulcus cells and the stria vascularis. In addition, an examination was made of the condition of the ganglion cells, the middle ear and the endolymphatic duct.

The mapping included every section of the tracer series in the basal turn, since previous studies have indicated this part as the most probable site of lesions affecting high tones. It included middle and apical turns to an extent sufficient to

Ear Number	Sex	Anatomical Number	Race	Age	Side	Inferred	Audiometer Readings			Histological Conditions in the Cochlea					
							Tinnitus		Syphilis	Nerve Fibers			Organ of Corti		
							Minutes	Hours		Root	Mid Ap	Base	Mid Ap	Base	Mid Ap
1 12272 L	#	-	-	10/15	10/10	0	0	5	-	20/19/20					
2 12272 R	#	(#)	-	25/20	10/15	0	-	5	-	20/19/20					
3 F W 8	w	-	-	10/10	5 5	0	-	5	-	25/19/20					
4 11759 L	w	-	-	15/10	5 5	0	-	5	-	30/19/20					
5 F W 29	w	i	-	0	5 0	0	-	5	-	0					
6 13510 R	w	i	-	10/10	5 5	0	-	5	-	10/10/10					
7 F W 49	w	-	-	15-5	10/0	0	0	20	35	20/45	ah	5/7			
8 1056 L	#	-	-	10/20	10/15	10	0	10	15	10	15	10	10	10	
9 F C 27	s	-	-	10/20	10/15	10	0	10	15	10	15	10	10	10	
10 11798 R	#	-	-	0	5	0	-	5	-	10	5	20	5	15	5/8
11 F W 27	n	-	-	5	10	5 5	10	5	0	5	25	10	5	10	5/8
12 12201 R	w	-	-	5	10	5 5	10	5	0	5	25	10	5	10	5/8
13 F W 24	n	-	-	10/20	5 5	10	10	20	45	ah	10	10	10	10	
14 11083 L	w	-	-	10/20	5 5	10	10	20	45	ah	10	10	10	10	
15 F C 33	(#)	-	-	10/20	5 5	10	10	20	45	ah	10	10	10	10	
16 1056 R	#	-	-	10/20	10/15	15	5	0	5	10	15	10	10	10	
17 F C 27	s	-	-	10/20	10/15	15	5	0	5	10	15	10	10	10	
18 12471 R	w	-	-	15/20	10/15	15	15	0	5	25	10	5	10	5	
19 F W 12	n	-	-	20/5	10/15	15	5	0	0	20	5	10	5	10	
20 4786 R	w	-	-	15/25	5/20	15	-	5	-	15/7					
21 F W 42	(#)	-	-	15/25	5/20	15	-	5	-	15/7					
22 4413 L	w	i	-	10/25	5/15	20	20	-	-	16/8					
23 F W 24	(#)	-	-	10/25	5/15	20	20	-	-	16/8					

Chart I. The control group of 16 ears, arranged in order of acuity, especially for 4,096 cycles. The first main section gives identifying data, together with reports on tinnitus and syphilis. The second section gives the results of hearing tests. The audiometer readings for the tones indicated are in decibels, and monochord readings indicate in kilocycles the highest tone heard for air conduction and bone conduction, respectively. The third section shows the histological condition of the cochleas; the amount of black filling indicates the degree of pathology in various regions from base to apex.

show their condition; usually every third section of the tracer series was examined, but in cases where evidence of pathology was found, all tracer sections were studied. The results are shown in Charts I-IV, all of which are made up in the same manner.

RESULTS.

Chart I shows the control group, and includes ears numbered 1 to 16, as indicated in the first column. The next

column gives data which identify the individual ear. First is the autopsy number, a four- or five-place number followed by "L" or "R" to designate left or right sides. Below this number is a letter "M" or "F" to indicate sex, a second letter "W" or "C" to indicate race (white or colored), and a number to show the age. In the third column is given in days or weeks the interval between the last audiometer test and the time of death. The fourth column indicates whether tinnitus was reported at the time of the test; the symbol "1" means that tinnitus was present, and "2" that it was severe in character, while "—" means that it was not reported. The fifth column indicates whether syphilis was diagnosed; "+" means that the Wassermann test was positive, "—" that it was negative, "±" that it was negative at the time of the test but that there was an earlier history of the disease.

The next 11 columns show the results of the audiometer tests. The numbers given are the readings of the 1A or 2A Western Electric audiometer, for which "0" means average normal hearing as the instruments are calibrated, negative values represent decibels better than average, and positive values, decibels worse than average. Results for tones below 256 cycles are not given. Failure to hear the tone at the highest intensity delivered by the instrument is indicated by "nh" (not heard). The next two columns show the results of tests with the Struycken monochord; the figures indicate in kilocycles the highest tone heard by air conduction (AC) and by bone conduction (BC).

The remainder of the chart shows the results of the histological study of the cochlea. The first section here indicates the condition of the nerve fibres, and the other sections the condition of the organ of Corti, external sulcus cells and stria vascularis, in that order. Each section represents to scale the linear extent of the cochlea and is divided into lower and upper basal, lower and upper middle, and apical turns. For each ear the degree of pathology is indicated by the amount of black filling.

For example, in ear No. 1 there is complete atrophy of nerve fibres in the first millimetre of the lower basal turn, then for a distance of 3 mm. only about four-fifths of the normal number of nerve fibres, then a normal area of about 1 mm., then a slight atrophic spot, and thereafter to the

apical end the condition is normal. The organ of Corti, shown similarly in the next section, is normal throughout. The external sulcus cells are highly atrophic in the first 3 mm. of the basal end, and normal elsewhere. The stria vascularis is atrophic at the extreme basal end, and slightly so at the apex, and otherwise normal.

This first chart shows that a moderate amount of pathology is present in ears that are within normal limits of acuity. Indeed, it is exceptional to find an ear that is histologically perfect; ears Nos. 8, 12 and 14 are most nearly so among those examined. Perhaps the most common defect is atrophy of nerve fibres at the lower basal end; and it is so common to find the nerve channel below the limbus only partially filled in this region that it is a question as to what should be regarded as the normal condition. Also common are scattered regions of moderate atrophy of the stria vascularis; but inasmuch as the rôle of the stria vascularis in hearing is doubtless of a very general nature, we can ascribe little significance to atrophies of a slight and local character. At any rate, the results prove that tones below 8,192 cycles are heard well in the presence of moderate atrophies.

The observations on middle ear and endolymphatic duct are not given in the charts because in none of the cases were there significant departures from normal. Slight to considerable adhesions of the posterior crus of the stapes to the adjacent wall of the promontory were occasionally found, but this feature is so common in ears with good hearing that it cannot be regarded as a serious lesion. In ear No. 2 a large growth was present on Reissner's membrane through about $2\frac{1}{2}$ mm. near the basal end, but since this ear showed excellent acuity, the anomaly is evidently of no significance.

Chart II shows, first of all, four "borderline" cases, ears Nos. 17-20. These are easily dismissed by pointing out that though the hearing for 4,096 cycles is somewhat below that of the control group, the histological picture does not differ in any striking way.

The next two rows of this chart represent ears Nos. 21 and 22, the only ones found with simple dips other than at 4,096 cycles. No. 22 shows a small dip at 2,048 cycles, and No. 23 a dip at 5,793 cycles. Neither of these ears showed a significant amount of pathology.

Chart III presents the results of the study of 32 ears with simple dips at 4,096 cycles. The arrangement is in order of acuity for 4,096 cycles, which varies from 30 deb. to 75 deb. below normal, or from smaller to larger dips. These ears show in general a greater amount of pathology than the control group. In more than half the cases a partial atrophy of nerve fibres extends over the entire lower basal half-turn, and in a few cases even farther. As a rule, in these instances, the atrophy is great at the basal end, and decreases rapidly as the spiral proceeds apically. In one case, ear No. 48, a

Ear Number	Sex	Age	Side	Interval	Tumors	Spiral	Audiometer Readings								Microtome Section	Histological Conditions in the Cochlea					
							512	1024	2048	4096	8192	16384	32768	65536	131072	262144	524288	1048576	2097152	4194304	8388608
Basal	Mid A	Basal	Mid A	Basal	Mid A	Basal	Mid A	Basal	Mid A	Basal	Mid A	Basal	Mid A	Basal	Mid A	Basal	Mid A	Basal	Mid A	Stria Vascularis	
17 3811 L	F	20	+	-	-	25	20	5	-5	20	-15	-	-	-	14	16	-	-	-	-	-
18 4413 R	F	24	+	1	-	10	10	20	15	25	30	-	-	-	15	18	-	-	-	-	-
19 3834 R	M	35	+	n	-	10	10	5	10	25	0	-	-	-	-	-	-	-	-	-	-
20 4447 R	F	19	+	-	-	25	25	20	0	25	5	-	-	-	-	-	-	-	-	-	-
21 4447 R	M	18	+	+	-	10	15	10	5	10	20	-	-	-	16	17	-	-	-	-	-
22 5793 L	F	29	+	+	-	10	20	5	3	20	40	15	20	15	10	18	-	-	-	-	-

Chart II. Above, four "borderline" cases. In these ears, there was a loss at 4,096 cycles compared with neighboring tones, but the loss was insufficient to meet the criterion used.

Below, two ears that contained dips at frequencies other than 4,096 cycles; one was at 2,048 cycles and the other at 5,793 cycles.

tumor was present in the modiolus but apparently had not affected the nervous tissues.

Likewise, for the organ of Corti, pathology is somewhat more common in this than in the control group; yet the atrophy is only slight and for the most part is confined to the extreme basal end. In a few instances, namely ears Nos. 25, 28, 33, 36, 40, 49 and 50, there are localized regions of partial atrophy of hair cells at or near the junction of lower and upper basal half-turns, yet it is doubtful that these can fully account for the specific losses of acuity; they are no more common for the larger dips than for the smaller.

Atrophy of external sulcus cells is much more common than for the control group, yet its degree and extent are no greater than the worst cases of the control group.

In a number of these ears the atrophy of stria vascularis is noticeably greater than that found in the control group,

and in two or three instances is rather severe in the apical region.

It is notable that a number of these ears show no more atrophy than is found in the control group. For example,

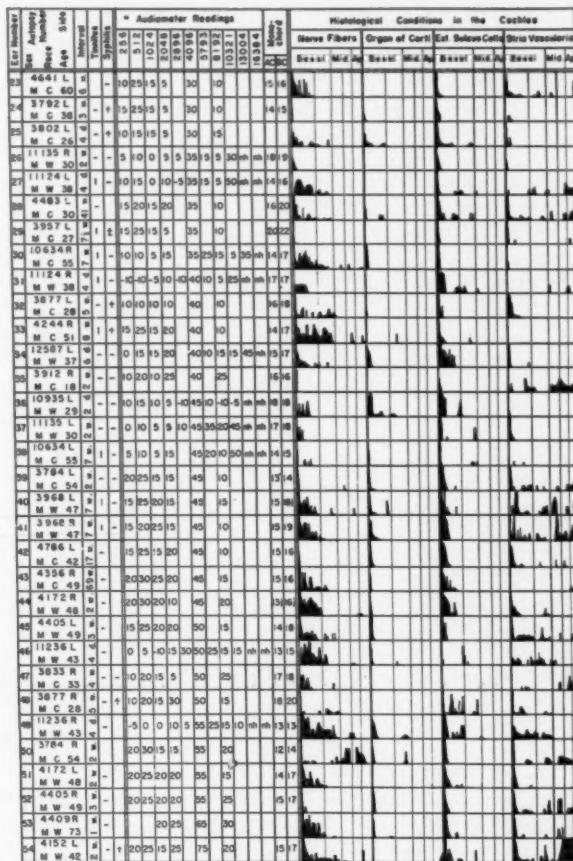


Chart III. The main experimental group of 32 simple dips at 4,096 cycles, arranged in order of acuity for that tone.

Nos. 24, 26, 29 and 38 show no more pathology than several ears in which acuity is normal. Moreover, there is little tendency for the ears with the deeper dips to show correspond-

ingly greater pathology, except possibly in the case of atrophy of stria vascularis.

Finally, no particular region of the cochlea is found which can certainly be correlated with acuity for 4,096 cycles; the atrophy that is present is nearly always at the basal end, except that for the stria vascularis, which is more scattered. Ear No. 50 is unusual in that most of the nerve atrophy is in the middle turn of the cochlea.

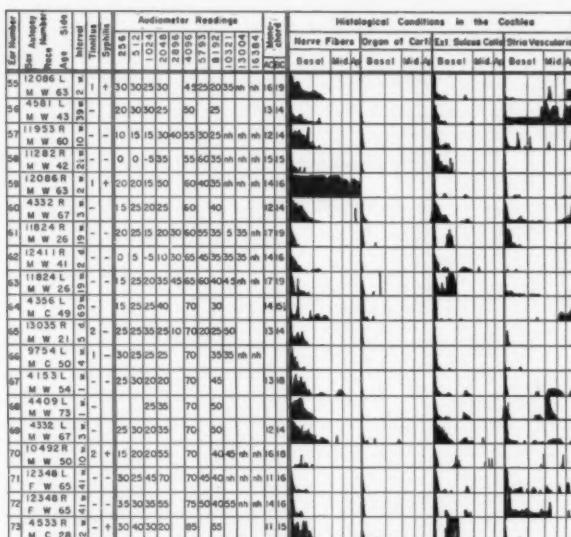


Chart IV. A group of 19 ears in which the dips were deep and wide. These ears did not always satisfy the criterion of normal acuity for tones outside the dip. The arrangement, as before, is in order of acuity for 4,096 cycles.

It must be borne in mind in considering these results that in a number of instances the acuity is poor for tones above 8,192 cycles, and also that in other instances no tests were made for these higher tones. It is likely that at least a part of the atrophy represents a loss for the highest tones; and insofar as high-tone loss and a tonal dip occur together, it is difficult to isolate their causes, if indeed their causes are distinct.

Chart IV shows 19 ears in which the dips were both deep and wide, and usually the highest ones were not heard. These

cases, as in the preceding chart, are arranged in order of acuity for 4,096 cycles. All but two of these ears were from males, and these two, Nos. 71 and 72, as already mentioned, were from a single individual.

The amount of pathology shown in this chart is slightly greater on the whole than that found in the preceding chart, yet its amount is hardly commensurate with the degree of auditory impairment, except in two or three instances. In No. 56 is shown a striking amount of atrophy of stria vascularis. In No. 63 is a sharply circumscribed but complete atrophy of the organ of Corti, which is exceptional. The most striking case here is No. 59, which shows very grave atrophy of nerve fibres; and there was in addition an equally serious atrophy of ganglion cells. In fact, it is difficult to understand how this ear could function as well as it did in the presence of the atrophy shown; tones up to 1,024 cycles were heard within normal limits, and those through the next three octaves, up to 8,192 cycles, were still heard, though poorly. With the monochord, bone-conducted sounds were audible up to 16,000 cycles. No satisfactory explanation can be given for this case; it is unique in the laboratory collection.

The above results may be briefly summarized. The tonal dip is not correlated in any convincing way with the histological condition of the cochlea. Generally speaking, ears containing dips, especially if they are deep and wide, show somewhat more atrophy than normal ears, yet there are many exceptions. No specific areas can be located whose condition varies in any consistent manner with the acuity for 4,096 cycles. The atrophies that are present are usually at the basal end, except for atrophies of stria, which are more widely scattered.

DISCUSSION.

Although, as pointed out, there is some tendency in the material as a whole for greater atrophy in the more impaired ears, it must be emphasized that the pathology found is much less than what might be expected from the functional impairment. A loss of acuity of 75 dcb., like that shown for ear No. 54, represents in terms of physical energy a departure from normal of more than 30 million-fold, or in other words a mechanical efficiency which has been reduced to only about

three-millionths of 1 per cent of normal. If there is any simple relation between the functional condition of the ear and its mechanical condition, we should expect to find a most devastating loss of such elements in the cochlea as are responsible for the hearing of the tone in question. If it can be assumed that some particular area of the cochlea serves the tone 4,096, then we should expect to discover an area of practically complete atrophy.

Crowe, Guild and Polvogt⁷ correlated losses of acuity for high tones with atrophies in the basal region of the cochlea. Their results suggested as the focal region for 4,096 cycles a position about 10 mm. from the basal end, which is nearly at the border of lower and upper basal half-turns. An inspection of the charts presented here reveals no consistent lesions in this location.

The failure to find a lesion in a particular region does not of course signify that the tissues there were operating in a normal manner. There is no certainty that functional impairments are revealed by the histological techniques used. Covell,⁸ for example, in a study of the effects of drugs on the hair cells of the organ of Corti, found that special techniques will make known minor alterations of structure which the usual treatments fail to reveal. The possibility remains that a particular region serves 4,096 cycles, and through its impairment a tonal dip arises. There are still other possibilities, but the present state of the problem hardly justifies their elaboration.

One of the most striking features of these results is the preponderance of dips among males. In this study, simple dips of any considerable magnitude were found almost exclusively in males. Of deep and wide dips, only two female cases were discovered. In contemplating these results, the ratio of males to females in the routine autopsies must of course be taken into account; this ratio for the laboratory material is about two to one for persons above 15 years of age. The larger proportion of males who come to autopsy by no means accounts for the results, and we must conclude that the relation to sex is an actuality.

The preponderance of tonal dips in males is perhaps not quite so overwhelming in the population as a whole as the

present data would suggest. The writer has made no systematic study on this point but an examination of extensive audiometer records of this laboratory (records other than those for which sections are available) revealed that simple dips in females do sometimes occur. Ciocco's work, cited above,⁵ was a statistical study of these same records, but, as already suggested, his broader definition of dips may not have revealed the entire picture. It seems likely that a more rigid classification would have given a great preponderance of dips in males for the older age groups, as well as for the younger. A further study of large numbers of cases, in which the different kinds and degrees of dips are treated separately, is plainly desirable.

The tonal dip is not the only auditory defect that is sex-related. Deafness in general is more common in males. High-tone deafness, and especially that classified as abrupt high-tone loss, is found far more often in males than in females.⁷

A number of speculations have been made as to the cause of the tonal dip. Drury⁸ supported the hypothesis that it is of syphilitic origin; others, however, have found no evidence of such a relationship. Ciocco⁵ reported about the same percentages of dips, as well as other types of auditory impairments, in individuals with and without syphilis. In the present study there is no indication of a greater frequency of syphilis among the cases with the more prominent dips; and, moreover, the diagnosis was negative in a significantly large number of these cases.

Fowler¹¹ discussed several possible causes of the tonal dip. One suggestion was that the dip arises from antiresonance in the conduction mechanism, perhaps through absorption of sound at certain frequencies by air spaces or thickened tissues. The writer found no evidence of such structural conditions in the ears studied. Also, a few cases tested by bone conduction as well as by air conduction have shown dips of the same character by both methods; and it seems unlikely that the conditions of resonance are the same in these two forms of conduction.

A second possible cause is a limited lesion of central nervous tissues; but, as Fowler suggested, the frequent appearance of unilateral dips tells against this possibility. In the present

study, there were 24 persons with unilateral dips and 15 with bilateral dips (borderline cases excluded).

Another theory of the origin of the dip is that it arises from a localized circulatory disturbance, but as yet there is no evidence on this point. The organ of Corti has no direct blood supply but is nourished by the endolymph, and it is difficult to imagine how circulatory failure could act specifically on one small region of frequency.

Perhaps the most favored theory of the tonal dip is that it is of traumatic origin. Ciocco suggested that the predominance of dips in males might be due to the more common exposure to industrial noises of an injurious character. However, it should be pointed out that dips occasionally are found in young boys who would not ordinarily be supposed to have been subjected to industrial noises. For example, in the records of this laboratory is the case of a boy, age 9 years, both of whose ears show a prominent dip at 4,096 cycles (no sections are available in this case). It is, of course, possible that young boys, as well as men, are exposed to the sounds of firearms, firecrackers and the like in greater degree than girls and women of all ages. Tests made by Rideout²⁰ on naval officers who had been exposed to gunfire throughout their careers yielded audiograms which were significantly poorer than the average of males of corresponding ages, especially in the region above 2,048 cycles. Bunch²¹ reported an instance in which the explosion of a firecracker was regarded as the cause of a broad tonal dip in the region of 4,096 cycles; in this case there was at least partial recovery, as shown by a second test two days later.

Ciocco suggested that the dip is a preliminary stage of high-tone deafness, and that the latter condition arises by the widening and deepening of the dip until the higher tones are completely lost.

There seems little doubt of the progressive character of the dip. Even a cursory examination of Charts III and IV shows that the deeper and wider dips are characteristically found in older persons. It is possible, however, that two processes are involved in certain cases of progressive deafness: one a true high-tone loss which begins at the upper limit of hearing and shades downward, and the other the appearance and

deepening of a dip. When these two effects converge in the region of 4,096 cycles the result is an abrupt high-tone loss. Since the dips are sex-linked, we may thus account for the fact observed by Crowe, Guild and Polvogt that abrupt high-tone loss appears in males and females alike.

Even if we accept the traumatic theory, or any other of the above theories of the origin of the dip, we are still faced with the puzzling question why the region of 4,096 cycles should predominantly be affected. What peculiarity of the auditory system can render one narrow region of the frequency scale particularly susceptible to degenerative changes? Conditions which might affect tones at one extreme of the scale are easily thought of. For example, the entrance of toxic substances through the round window has been suspected. Another possibility is the higher concentration of waste products in the endolymph of the basal region, which can reasonably be predicated, since Guild has shown that the endolymph flows from apex toward the base on the way to the endolymphatic duct;¹³ however, neither of these conditions can easily be supposed to affect a region in the middle of the basal turn, where such evidence as we have for cochlear localization places 4,096 cycles.⁷

The first suggestion that the writer has to offer here is that 4,096 cycles lies in the region of resonance of the inner ear. This assumption is reasonable, inasmuch as the region of greatest acuity for the ear as a whole is only a little below, in the general area of 1,500 cycles, and measurements of the response of the middle ear itself have indicated resonance around 800 cycles. Now, it may very well be that any deleterious condition will most seriously affect the inner ear in the region where its sensitivity is greatest to begin with. Indeed, there is good evidence for this relationship in animals subjected to long-continued stimulation with deafeningly loud tones: any effects, regardless of the frequency of the stimulating tones, are always found about the middle of the scale, perhaps a little above the region of greatest sensitivity for the ear as a whole.^{8, 22}

It is possible also that the attainment of the high degree of sensitivity which obtains in the region of 4,096 cycles carries with it a disadvantage in the form of particular delicacy. The writer has found some evidences for such delicacy

in the study of the sectioned material. Ears which have suffered a moderate amount of postmortem autolysis usually show differences in the type of preservation in different regions of the cochlea. Characteristically, the most severe autolytic changes are found in the upper and middle portions of the lower basal half-turn. The changes vary in degree in different instances, but typically consist of a rupture of the outer portion of the reticular membrane, with partial or complete involvement of the Hensen cells. In the advanced stages this process amounts to a displacement and even a disappearance of the Hensen cells and of nearly the whole of the reticular membrane. The hair cells are not necessarily missing, even in the severe cases, but are usually out of their normal posi-

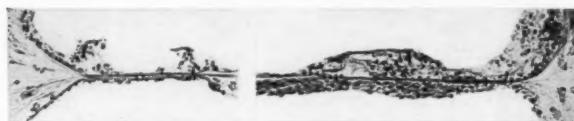


Fig. 2. Photomicrographs showing the condition of the organ of Corti in the basal turn of the right ear of a man, age 65 years. Both photomicrographs are from the same section; that on the left shows the condition in the lower basal region, that on the right in the upper basal region. Note the structural defect in the reticular membrane and Hensen cell region in the lower basal half-turn. This condition extended throughout most of this half-turn, as seen in the next figure.

tions, and often are found in conglomerate masses in occasional sections.

Fig. 2 illustrates these autolytic changes in the right ear of a man, age 65 years. On the left is a photomicrograph of the organ of Corti from the lower basal half-turn, and on the right a photomicrograph from the upper basal half-turn in the same section. In the lower basal half-turn there is a large defect in the reticular membrane and Hensen cell region, but in the upper basal half-turn these parts are intact. In both there are abnormalities in the inner hair cell region, but these are slightly more marked in the lower basal half-turn.

In this ear the defect described extended from about 2 mm. from the basal end to about $9\frac{1}{2}$ mm. from the basal end. The defect graded off somewhat at beginning and end: for three tracer sections on the lower end and for seven tracer sections on the upper end the amount of damage was less than in the intermediate region. These differences are shown in the

spiral diagram of Fig. 3. In this diagram the condition of nerve fibres, organ of Corti, external sulcus cells and stria vascularis is shown in detail throughout the basal turn. Here the amount of filled-in-space represents the degree of normal structure. The organ of Corti is represented by one of the middle spirals, which consists of a series of quadrilaterals. For the sections in which the organ of Corti was intact, the quadrilateral is filled in with black, and the presence of the normal number of hair cells is shown by the large white dots. A small dot indicates that the judgment of the



Fig. 3. Spiral diagram of the right ear of a man, age 65 years, to show details of structure throughout the basal turn. The condition of the organ of Corti is indicated by the quadrilateral figures; when this part is normal the figure is completely filled in and contains a full complement of hair cells, as shown by the large white dots. Small dots signify that the identification of the hair cells was uncertain. A portion missing from the top of a quadrilateral indicates a defect of structure, which in extreme cases included reticular membrane and Hensen cells, and sometimes the hair cells as well.

condition of the hair cell was doubtful. A missing portion at the top of the quadrilateral shows the absence of reticular membrane and Hensen cell region, which is the particular point of interest here. This ear suffered a marked dip at 4,096 cycles.

The regional differences described are characteristic, in that they are found repeatedly in ears with a moderate degree

of postmortem autolysis, as judged by other tissues. Sometimes, when the autolysis is extreme, the same structural changes are found in all turns of the cochlea.

These changes are found in ears with normal as well as defective hearing. It is difficult to account for them in the handling of the tissues, in the entrance of preserving fluids, or through exposure to osmotic pressures, as any of these effects should vary regularly throughout the extent of the cochlea. In well preserved ears there is no visible evidence of fragility in the region in question; but if such fragility is a general characteristic, it may be one of permeability or susceptibility rather than an obvious structural condition.

The above evidence is in line with the observations of Crowe, Guild and Polvogt on high-tone loss. They found that in many cases of abrupt high-tone loss there is marked atrophy of the organ of Corti, as well as of nerve fibres, in the lower basal region, whereas in cases of gradual high-tone loss there is usually atrophy of nerve fibres but little atrophy of the organ of Corti. Oda, more recently, made similar observations.

From these considerations it still appears possible that the 4,096 cycle dip is due to impaired functioning of the organ of Corti in a region of the lower basal half-turn, despite the fact that such impairment is not revealed to microscopical examination by the techniques used for this material. It may be that another mode of histological treatment, similar to that afforded, incidentally, in a few cases by moderate post-mortem autolysis, will provide a final answer to the problem.

SUMMARY.

An investigation was made of the structural conditions underlying the tonal dip by examination of serial sections of a number of temporal bones of persons whose audiograms indicated a marked local depression of sensitivity.

It was found that a rigid criterion of selection, which excluded general losses of sensitivity, gave a great preponderance of dips among males, and that the dips in nearly all cases were at a frequency of 4,096 cycles.

The results showed a somewhat higher degree of pathology of inner ear structures in cases in which large dips were

present, but no region was identified as specifically responsible for the local depressions.

Various theories as to the cause of the tonal dip are discussed, and the suggestion is made that the lower basal portion of the organ of Corti is one of particular fragility.

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Eno Hall.

LYMPHOID TISSUE IN THE UPPER RESPIRATORY TRACT.*

DR. D. C. JARVIS, Barre, Vt.

Dr. D. Bryson Delavan in his 1928 address as President of the American Laryngological Association made the following statement: "There is no more urgent need today than that of an intensive thoroughly scientific investigation of the physiology and pathology of the lymphoid structures of the pharynx, especially as relating to causes, metabolic or otherwise, which contributed to its common pathological changes. I earnestly commend this to your early and serious consideration."

I was very much impressed by this statement and on my return home began a clinical study of the behavior of lymphoid tissue in the upper respiratory tract. At this time I wish to report the observations made.

RELATION OF IODINE TO LYMPHOID TISSUE.

During 1915, while engaged in a detailed study of silicosis in an effort to find the type of individual not susceptible to the early ill effects of granite dust inhalation, I observed that lymphoid tissue was present on the posterior pharyngeal wall in proportion to the absence of fats in the daily food intake. Later it was discovered that this observation could also be made when having contact with patients during the day's routine.

Continued interest in fats disclosed the fact that they have an iodine number. If measured fat and measured iodine are added to a container, a certain amount of iodine will be taken up by the fat. If the free iodine remaining in the container is now measured, the deficit which has combined with the fat will represent the iodine number of the fat.

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The iodine number of some of the more common oils is as follows:

Oil	Iodine Number
Linseed Oil.....	200
Mazola Oil	120
Olive Oil.....	86 to 90
Cotton Seed Oil.....	115
Cod Liver Oil.....	170
Palm Oil	53
Cocoanut Oil	8
Almond Oil	95

Apparently, then, the individual who includes fat in his daily food intake picks up iodine in his intestinal tract. This iodine along with the fat enters the body, where it performs a definite function in the body. One result of this function is observed in the behavior of lymphoid tissue in the upper respiratory tract.

Following this observation, I began prescribing Amend's solution of iodine by mouth. Two drops in a glass of water 20 minutes before each meal were prescribed. The object of this small dose was to create a glass of iodized water. Patients began reporting that the medicine had helped the breathing capacity of their nose so that they were able to breathe through each side of their noses much better. I observed that along with the decrease in size of the turbinates, the lymphoid nodules on the posterior pharyngeal wall also disappeared.

H. I. Lillie in his paper, "The Clinical Significance of Compensatory Granular Pharyngitis," presented before this Society in 1936, writes as follows:

"There is a type of granular pharyngitis seen in certain individuals following the removal of infected tonsils that may be looked on as compensatory in nature. When it occurs, it causes unpleasant symptoms. The best method of treatment that has yet been found is ingestion of iodides on an empiric basis. The results have been satisfactory and continued use will be made of this method of treatment."

Iodine has been used empirically in clinical conditions of the nose and throat for many years in the form of iodine nose drops, the painting of the throat with iodine and glycerine and the use of an iodine gargle.

It seems possible to conclude from the foregoing observations that iodine taken into the body reduces the size of lymphoid tissue in the upper respiratory tract. If this is true, then the displacement of iodine so that it leaves the body should result in increase in the size of upper respiratory tract lymphoid tissue.

RELATION OF LAW OF HALOGEN DISPLACEMENT TO LYMPHOID TISSUE.

Let us turn to a consideration of the well known chemical law of halogen displacement. The halogen group with their relative atomic weights is made up as follows: 1. Fluorine, 19. 2. Chlorine, 35.4. 3. Bromine, 79.92. 4. Iodine, 126.92.

The clinical activity of any one of the halogens is in inverse proportion to its atomic weight. This means that any one of the four can displace out of a compound any other one which has a higher atomic weight. Any one can displace the element having a higher atomic weight but cannot displace one below it. For example, fluorine can displace chlorine, bromine and iodine. Chlorine can displace bromine and iodine. Bromine can displace iodine. A reverse order is not possible. Chlorine can displace iodine but iodine cannot displace chlorine.

A practical application of the law of halogen displacement is seen in the treatment of bromine poisoning. Large doses of sodium chloride are prescribed. The chlorine in the sodium chloride causes the bromine to quickly leave the body with recovery from the bromine taking place.

If the law of halogen displacement works as well inside the body as outside, and chlorine displaces stored iodine which influences the behavior of lymphoid tissue in the upper respiratory tract, then in a city using chlorine filtered water, lymphoid tissue in the upper respiratory tract should be more in evidence.

Following an address on "Applied Biochemistry in Everyday Medicine," in a city of 60,000 having chlorine filtered water, the leading internist said to me, "I have charge of the children in an orphan asylum. When they are admitted from other parts of the State they will show normal tonsils on examination. After they have been in the orphan asylum for

six months, their tonsils will be as large as they can be. Can you tell me why this is so?" I replied I believed he was dealing with an application of the well known chemical law of halogen displacement, which seems to work as well inside the body as outside. The chlorine in the drinking water displaced the iodine stored in the body. When the stored iodine fell below a certain level, the lymphoid tissue in the throat increased in size.

I asked the leading pediatrician in the same city what his attitude was towards tonsillectomy. He answered that he had stopped recommending tonsillectomy. Children having a tonsillectomy returned to him later with the posterior pharyngeal wall covered with enlarged lymphoid nodules. He realized he only exchanged one set of clinical troubles for another when he advised tonsillectomy.

While the operation of tonsillectomy may have been well advised, failure to recognize the part chlorine in the water supply played in bringing about an increased amount of lymphoid tissue in the upper respiratory tract by displacing stored iodine in the body prevented the expected favorable result which should have followed the operation. Small doses of iodine, one or more times each week, would have prevented the appearance of the undesired lymphoid nodules on the posterior pharyngeal wall.

CALCIUM.

Becoming interested years ago in a study of the environmental factors that might have an influence on the health of the individual, I learned that because of the large deposit of marble beneath the soil, the drinking water in my part of Vermont, whether from spring or river, was rich in calcium oxide and contained a trace of iron and magnesium.

So great is the amount of calcium in the drinking water that every two months the calcium deposited on the inside of teakettles has to be removed by scraping. Those having an oil burner with hot water coil in the kitchen range find it necessary to purchase a new coil each year because the old one becomes filled with deposited calcium. The large hot water tank in the building where my office is located deposits an inch of calcium on the inner wall every five years. It is a

common occurrence for the hot water drawn from the faucet to look like milk because of the presence of calcium which has been precipitated by heat.

Knowing those living in this environment were daily taking in a large amount of calcium because of the rich calcium content of the water supply, I concluded there must be present a group of clinical conditions which appeared as a result of the biochemical effect within the body of this excess of calcium.

This list of clinical conditions worked out during the years includes hay fever, asthma, impaired hearing, neuritis, arthritis and heart disease. The list of symptoms depending on faulty calcium metabolism worked out during these same years includes dizziness, headache, tinnitus, impaired nasal respiration and edema.

Later I learned that according to the draft maps of the World War, Vermont leads the country in amount of hay fever and asthma present. We are second only to Maine in the amount of impaired hearing. According to the statistics of the American Heart Association, Vermont has the highest death rate from heart disease of any State. We have a great deal of arthritis and neuritis.

Unless one is familiar with the significance of calcium in cellular physiology it is difficult to understand the functional changes which may result from a disturbance of calcium metabolism.

The life and functional integrity of the individual cell is dependent upon the interchange of material between its interior and the surrounding medium, which is the intercellular fluid.

Food material and oxygen must pass into the cell and the products of cell metabolism resulting from the vital activity of the cell must pass out. This interchange depends upon the permeability of the cell membrane. Calcium diminishes cell membrane permeability. On the recognition of this fact rests the proper appreciation of the physiological and pathological significance of calcium.

Decreased permeability of the cell membrane results in an increase of intercellular fluid, which may increase to the

point where visible edema is present. This increase of inter-cellular fluid interferes with its proper rate of movement which is necessary in order to bring the proper quality and quantity of food material and oxygen to the cell and to promptly remove the waste material resulting from the vital activity of the cell.

Calcium directs its action through the sympathetic division of the autonomic nervous system. It acts much the same as stimulation of the sympathetic division. A constant excess of calcium overstimulates the sympathetic division, resulting in exhaustion of the sympathetic, which leaves the parasympathetic division dominant.

Calcium and phosphorus being associated together in the blood in the proportion of 10 parts of calcium and four parts of phosphorus in the formation of the compound calcium phosphate, it was only natural that some easily observed clinical method be sought that would enable the examiner to estimate whether the patient as a rule carried a high or a low blood calcium level.

Continued clinical observation checked with many blood calcium-phosphorus determinations disclosed the fact that when the blood calcium level is high and the blood phosphorus is low there is a deposit of calcium on the lingual side of the lower front teeth.

The source of saliva is the blood stream. If the calcium level in the blood is high, the saliva will also have a high calcium content. This high calcium content saliva as it leaves the submaxillary and sublingual salivary glands enters the mouth by ducts which open on the floor of the mouth under the tip of the tongue. It naturally comes in immediate contact with the lingual side of the lower front teeth, where a deposit of calcium in the form of calculus takes place. A study of the lingual side of the lower front teeth while examining a patient gives one a working knowledge of the blood calcium level.

Another index to the calcium content of the blood is the color of mucous membrane in the nose, especially the turbinates, that covering the soft palate and that covering the gums of the upper front teeth. When the mucous membrane is pale the blood calcium is high. When it is red the blood cal-

cium is low. The varying degrees of pallor or redness of mucous membrane serve as an index to the blood calcium level, whether high or low.

An excess of calcium and an insufficient amount of phosphorus in the blood permits the formation of the compound calcium phosphate in limited amounts. An excess of calcium is left over. This excess of calcium is deposited in various parts of the body, such as the lens of the eye and the tissues of the middle ear. Continued clinical observation leads one to conclude that this excess of calcium opposes hypertrophy of lymphoid tissue. Its presence favors the development of clinical conditions we have come to associate with allergy, such as hay fever, asthma, hives and the like. The presence of this excess of calcium places the patient in what may be called the edema zone.

In order to remove this excess of calcium it is necessary to:
1. Increase the phosphorus level of the blood. 2. Prescribe therapeutic agents that raise the blood phosphorus. 3. Prescribe a diet that will raise the blood phosphorus and lower the blood calcium.

There are a number of therapeutic agents which blood studies show raise the blood phosphorus level. This list includes vitamin D, 1/10 gr. doses of thyroid, kelp tablets and dilute hydrochloric acid. Clinical observation not controlled by blood calcium-phosphorus determinations indicates that vinegar also raises the blood phosphorus level. Citrus fruits appear to lower blood phosphorus.

As for diet, the patient is asked to avoid wheat food, wheat cereals and white sugar because blood calcium-phosphorus studies show that these three produce a high calcium low phosphorus level in the blood. Milk as a beverage is avoided, as well as citrus fruits and citrus fruit juices. He is asked to use rye or corn meal foods, honey, internal organs of animals, seafood, fish, eggs, cheese, fowl, milk in cooking, grape juice and cranberry juice.

It must be remembered that the therapeutic effect of any therapeutic agent depends in a large measure on whether calcium or phosphorus is in excess when the therapeutic agent is prescribed and whether the autonomic nervous system pattern is represented by a dominant sympathetic division or a dominant parasympathetic division.

PHOSPHORUS.

Now, let us turn to a consideration of phosphorus. While carrying on a series of clinical experiments in which dilute hydrochloric acid taken on an empty stomach in varying doses was used to determine the size and frequency of the dose which would best shift the nasal mucous membrane color in the nose from pale to red, I discovered patients developed a soreness in the pharyngeal region when a total daily dose of 40 to 60 drops was taken each day in 10-drop doses in a glass of water, on an empty stomach, for a period of weeks. Generally from six to eight weeks is necessary to produce this result.

Examination of the pharynx showed that lymphoid nodules on the posterior pharyngeal wall and lymphoid bands just posterior to the posterior tonsillar pillar had made their appearance. It became quite evident as this clinical observation was repeated on different individuals that a relation existed between the intake of dilute hydrochloric acid and the appearance of lymphoid tissue in the pharyngeal region. The question then arose as to what action dilute hydrochloric acid had that produced this effect on lymphoid tissue in the upper respiratory tract.

In 1934 I began collaborating with Dr. Melvin E. Page, of Muskegon, Mich., who is a nationally known research dentist. His practice being limited to preventive dentistry, he does a routine blood calcium-phosphorus determination on patients as a basis from which to work in preventing dental decay. Up to the writing of this paper he had made approximately 7,000 determinations of blood calcium and blood phosphorus. In checking up my observation on the relation of dilute hydrochloric acid to the behavior of upper respiratory tract lymphoid tissue, he reported that in doses such as I used, the blood phosphorus was raised. Apparently, then a relationship exists between the blood phosphorus level and the size of lymphoid tissue in the upper respiratory tract.

If dilute hydrochloric acid in 10-drop doses in a glass of water taken when the stomach is empty, four times a day over a period of weeks, brings about the appearance of lymphoid tissue in the upper respiratory tract, is it possible to produce in an individual with known blood phosphorus read-

ings over a period of years, a sore throat by experimentally raising the phosphorus level of the blood?

This clinical experiment was tried, with the result that a sore throat, dependent on increase in size of lymphoid tissue, could be made to appear and disappear by raising or lowering the blood phosphorus level.

I asked Dr. Page to help me work out the relationship between mucous membrane color and the blood phosphorus level. This he did and reported that when the mucous membrane covering the gums or mucous membrane in the nose was pale, the blood phosphorus level was low. When the mucous membrane color was red the blood phosphorus level was high. The varying degrees of pallor or redness served as an index to the blood phosphorus level, whether high or low.

The next step was to learn what effect a ration known to be high in phosphorus had on small animals, such as growing chickens represented. A friend who is interested in animal nutrition and continuously carries on nutrition experiments on poultry and animals, both large and small, carried out the following experiment in order to learn the effect of an increased phosphorus content of the ration on chickens.

A hatch of 1,000 chickens was divided, placing 500 in one brooder and the remaining 500 in another brooder in adjoining pens, all conditions as identical as it was possible to make them, with the exception of the feed.

The first pen was fed a commercial ration to which inorganic minerals had been added, the 12 per cent ash content of the ration being rich in phosphorus. This group of chickens was very nervous, jumpy and frightened at the approach of a stranger to their brooding pen, as they would be if a hawk was circling overhead in the sky. They were caught with difficulty, and only so by rushing them into a corner and then seizing a handful of them.

The second pen, fed upon a simple grain ration containing liberal quantities of corn meal and seaweed for its organic content, were more tame than the customary group of leg-horn chickens; in fact, the attendant, a woman, found that any time she bent over the pen, the chickens gathered around,

picking at her hands and talking to her as contented chickens always do. They carried their heads lower and were very easily handled. They were broke to roost early, whereas the other pen would not content themselves on roosts until two or three weeks later.

Following these observations made on leghorn chickens, I began studying the nervous, irritable, impatient and restless child who came under my care. Apparently a high blood phosphorus level may manifest itself in an increased size of upper respiratory tract lymphoid tissue or an increased irritability of the nervous system. Both need not necessarily be present at the same time. If this be true, then iodine in small doses should relieve the irritability, impatience and restlessness, as well as decreasing the size of lymphoid tissue in the upper respiratory tract.

Clinical observations showed that in children under 10 years of age it is possible to repeatedly change an irritable, impatient and restless child into a calm, patient individual within two to three hours' time by giving one to two drops of Amend's solution of iodine by mouth in a glass of water, or equal parts of water and grape juice or cranberry juice, one or more times each day. Three drops of Amend's solution of iodine in a glass of water will, as a rule, produce the same result in an adult.

If phosphorus produces impatience, irritability and restlessness, and iodine relieves these three conditions, it seems reasonable to conclude that iodine is antagonistic to phosphorus or is necessary for its metabolism and, therefore, would be expected to reduce the size of lymphoid tissue in the pharyngeal region which a high phosphorus level in the blood has brought about.

If an increased blood phosphorus level is associated with increased activity of the nervous system, then a low phosphorus blood level should be associated with chronic fatigue. Dilute hydrochloric acid, by mouth, as a means of raising the blood phosphorus level should enable the individual to overcome fatigue.

Using mucous membrane color as an index to the blood phosphorus level, with a red mucous membrane indicating a high blood phosphorus level and a pale mucous membrane

indicating a low blood phosphorus level, it was observed that chronic physical fatigue was most often associated with a pale mucous membrane. Individuals showing a pale mucous membrane never seem to tire mentally but easily develop physical fatigue.

Clinical observation discloses the fact that physical fatigue is relieved by dilute hydrochloric acid in five-drop doses in a glass of water taken on an empty stomach, one hour apart, until the fatigue is banished. Often only one five-drop dose is all that is needed. Four such doses usually represent the maximum amount of dilute hydrochloric acid required to relieve physical fatigue.

As the blood phosphorus level seemed so important in clinical medicine, I asked Dr. Page how blood phosphorus readings compared with blood calcium readings. In due time I received a report that out of 745 blood calcium-phosphorus determinations made in patients showing dental decay, only 85 were too low in calcium, while 235 were too low in phosphorus level. These figures would indicate that the phosphorus level is three times more important than the calcium level when considering the subject of dental decay. This seems to hold true when dealing with the clinical problems of medicine.

Dr. Page tells me it is impossible to secure a true blood phosphorus or a true blood calcium level reading as long as the individual includes white flour and white sugar foods in the daily diet. Both of these bring about a high calcium and a low phosphorus level in the blood. In order to obtain a true blood phosphorus level and a true blood calcium level reading, these two foods must be omitted from the diet for at least one week. The correct proportions of blood calcium and blood phosphorus are 10 of calcium and four of phosphorus. Any other reading indicates a raised or lowered calcium or phosphorus.

During the cold weather months in northern Vermont the tonsils are generally found to be larger in size than during the warmer months of the year. In seeking the cause of this I turned to a study of the several volumes by Dr. William F. Petersen, of Chicago, on "The Patient and the Weather."

On page 703 of Part 2 of Vol. 1, the following appears: "During the months of February and March we have the

lowest calcium levels; at the same time there is an increase in the phosphate level of the blood. With the summer, blood calcium increases." Here, again, we find an increased size of tonsils with an elevation of the blood phosphorus level.

I have observed that individuals showing clinical evidence of a low blood phosphorus level continually seek foods which are yellow in color. As a rule they are butter eaters. They are very fond of corn in any form, sweet potatoes, carrots, bananas, parsnips, celery, squash, pumpkin, etc. From this observation I suspect that yellow foods raised the blood phosphorus level.

An excess of phosphorus and an insufficient amount of calcium in the blood permits the formation of the compound calcium phosphate in limited amounts. An excess of phosphorus is left over. Continued clinical observation leads one to conclude that this excess phosphorus is stored in lymphoid tissue and as need for such storage increases, lymphoid tissue increases in size. The presence of this excess phosphorus places the patient in the inflammation zone.

In order to remove this excess of phosphorus it is necessary to: 1. Increase the calcium level of the blood. 2. Increase the intake of iodine. 3. Remove from the diet foods known to increase the intake of phosphorus. 4. Increase the intake of molasses or honey, which lower the blood phosphorus level.

SUMMARY.

1. Iodine reduces the size of lymphoid tissue in the upper respiratory tract.
2. Iodine in the body may be displaced by chlorine in chlorine filtered drinking water. When the stored iodine falls below a certain level, lymphoid tissue in the upper respiratory tract is apt to increase in size.
3. Calcium in excess opposes the hypertrophy of upper respiratory tract lymphoid tissue.
4. Phosphorus in excess favors hypertrophy of upper respiratory tract lymphoid tissue.
5. The problem of upper respiratory tract lymphoid tissue leads to a consideration of calcium and phosphorus metabolism.

107 North Main Street.

PETROSITIS WITH CONTRALATERAL SYMPTOMS.

DR. EARL H. BROWN, Tucson, Ariz.

Involvement of the petrous tip of the temporal bone as a result of an extension of infection from the mastoid process has been properly called petrositis. This condition has been widely discussed at otolaryngological meetings and in the literature during the past few years. All otolaryngologists now are familiar with the symptoms and are awake to the possibility of the occurrence of this complication of ear infection. The classical symptoms of petrous tip pathology are: 1. pain in the region of the eye; 2. double vision when looking in the direction of the affected side; 3. usually some localized headache.

The physical signs are: 1. low grade sepsis with suppuration from the middle ear or the mastoid wound; 2. weakness of the external rectus muscle.

X-ray of the petrous tip may show involvement of the petrous tip.

These signs and symptoms are practically always on the same side as the diseased process. The writer recently had a case with infection in the right temporal bone and symptoms entirely on the opposite side. Since Bristow¹ reported a similar case recently, it may be that this picture occurs more often than has been brought out.

Several different operative approaches have been devised to drain the petrous tip. The most notable ones are the techniques of Eagleton² and Kopetzky.³ Myerson, Rubin and Gilbert⁴ described an operative approach through the retropharyngeal space. The case to be reported recovered without any petrous tip operation by spontaneous drainage through the retropharyngeal space and the simple mastoid wound.

Towson⁵ has recently made a thorough review of the literature on this subject, so no further comment on this will be made.

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Case Report: Mrs. J. L. S. reported to the office, Feb. 18, 1938. She complained of pain in the right parietal region and in the right posterior occipital area following a head cold. There was no pain or discharge from the right ear. She stated that five years previously and again three years ago she had similar attacks. At both times she was advised to have a mastoidectomy but refused. Examination of the nose and throat was entirely negative except for a mild subsiding rhinitis. Both eardrums were entirely normal in appearance. There was no mastoid tenderness. Her temperature was normal; pulse rate, 72; respiration rate, 18. Blood count showed 14 gm. per cent hemoglobin, a red blood cell count of 4,140,-000, white cell count 9,000 with 63 per cent neutrophils. Urinalysis was negative. X-ray of the sinuses was negative. X-ray of the mastoids was reported as follows:

"The right mastoid presents a generalized hazy clouding. There are no cells visible in the outer mastoid process, only a large area of rarefaction noted in this region. The periantral triangle shows considerable haziness with only a slight suggestion of a few cells present.

"The anterior lateral sinus wall is somewhat prominent. The squamous cells show clouding, with the squamous tegmen considerably thickened.

"The left mastoid is normal in appearance. Cells are well aerated, well outlined and no definite pathology is demonstrated.

Summary: These radiographs demonstrate a chronic mastoiditis of the right side with probable destruction. The left mastoid is essentially normal."

There was no reason from the examination of the ear to suspect mastoid involvement, but the history prompted us to have the X-ray studies.

Operation was refused at this time, so the patient was treated with short wave diathermy and anodynes. We did not consider her a subject for sulfanilamide on account of poor kidney and liver function. There was no improvement symptomatically. On March 3, 1938, the white blood cell count was 15,600 with 81 per cent neutrophils. Since she had had no relief from the headaches she finally consented to surgery. On March 4, 1938, a mastoidectomy was performed under

ether anesthesia. The outer cortex of the right mastoid was very hard and sclerotic. After removing a considerable amount of this eburnated bone with a gouge, a large necrotic area of broken down cells, filled with granulation tissue and pus, was encountered; this was exenterated. The aditus from the middle ear was scaled off from the necrotic area and was entered only after removing sclerotic bone in the antrum area. There was a small dural exposure, which was enlarged to about a 6 mm. opening. There was no exposure of the lateral sinus. No fistula leading into the petrous apex was encountered, but there was some soft bone extending down to the perilabyrinthine cells. The wound was closed with skin suture, and one rubber tube for drainage. The patient made an uneventful recovery from the operation, but on the fifth postoperative day began to complain of pain in the left parietal region, which persisted. She was discharged from the hospital to convalesce at home on the twelfth postoperative day. On the fourteenth postoperative day she began to complain of dysphagia, as well as of left parietal pain, and at this time began to run a low grade septic temperature. Examination of the throat revealed what appeared to be an acute nasopharyngitis. The mastoid wound looked healthy, with a slight amount of drainage. Three days later the right side of the pharynx was full and upon incision several ounces of serous escaped. The patient improved somewhat but the low grade temperature persisted. A week later the pain in the left parietal region was unimproved and associated with pain in the left ocular region and double vision on looking to the left. The pharynx continued to drain pus. There were two days of marked discomfort — left parietal and ocular pain, fever and double vision. We were considering reopening the right wound and also opening the left mastoid, even though X-rays were negative for left-sided involvement. We were dubious about trying to do any petrous tip surgery on account of the patient's age and poor general condition. On the day we had decided upon for the second operation, the right mastoid wound swelled and drained profusely and all symptoms disappeared. The patient began to improve continuously. The pharynx and mastoid wound drained for a period of three months. A small sinus leading down into the labyrinthine area was left packed open and then finally allowed to heal. The pharyngeal wound healed spontaneously. The patient has

now been entirely free from symptoms and perfectly well for a year from the time of closure of the mastoid and pharyngeal fistulas.

This was a case of petrous tip infection which finally drained itself through the nasopharyngeal and mastoid fistulas. The contralateral symptoms were very unusual and confused the picture a great deal. Bristow^{*} explained his similar case on a toxic basis. Possibly other cases with contralateral symptoms have occurred and have not been reported.

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Thomas-Davis Clinic.

NONSURGICAL TREATMENT FOR DEAFNESS.*†

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PART I – PSYCHOTHERAPY, PROSTIGMIN, RADIOTHERAPY, ETC.

When this paper was first projected, the intention was to discuss the use of prostigmin for the treatment of chronic deafness in adults, but experience in trying to evaluate the efficacy of this treatment paralleled experience with so many other treatments that it seemed worth while to broaden the subject and discuss nonsurgical treatments in general. In a way, this paper is an answer to the men who ask, "If you can't operate on a patient or cure him with inflation, what can you do for deafness?" It reflects the internist's approach to therapeutics in contrast to the average surgeon's. The ear, nose and throat man tends, like the latter, to lose interest if he cannot operate, forgetting that there are many other less direct things which can be done to help the patient. I shall try to elucidate certain general principles in the management of the deafened, and will give a few helpful hints that should be of practical value, and report positive, as well as negative, results in the treatments with which we have had the most experience. I shall not discuss the treatment of suppurative otitis. This is a subject unto itself, but much of what is said will, of course, also apply to deafness from suppurative disease.

In going through my private charts, and those from special deafness clinics, it was found that the greatest improvements in hearing were obtained in acute cases and in children. The percentage of cases in which unquestionable improvement in the hearing mechanism was produced for adults was not great, but something constructive could be done for most of them. Incidentally, there were a few brilliant results in which the original diagnosis or prognosis had been wrong, proving that one cannot be categorical about one's early findings.

*Read before the New York Academy of Medicine, Section on Otolaryngology, Feb. 19, 1941.

†From the Department of Otolaryngology, College of Physicians and Surgeons, Columbia University, Vanderbilt Clinic, The Conservation of Hearing Clinic of the New York League for the Hard-of-Hearing at the Manhattan Eye, Ear and Throat Hospital.

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A great many chronic cases of long-standing conscientiously returned for treatments, convinced that they were materially helped, in spite of the fact that there was no significant change in their threshold audiograms. The good done in this group was in the management of the patient as a whole, rather than any actual improvement of his hearing *per se*. On the other hand, it was found to be very difficult to manage the patients unless some specific treatment was given. They would keep their appointments for lip-reading lessons if they also received injections which they believed were of benefit. This is a common type of experience in psychiatric practice.

There is always something which an honest and well informed doctor can do to help the patient, and meanwhile build up a knowledge of his psychological make-up and his disease. Very few human beings can face a naked, unpleasant truth without informed and sympathetic guidance, and the physician who routinely tells a patient on the first visit that there is nothing that can be done often does more harm than good. He tends to force the patient to go to some quack, who will tell him what he wants to hear; *i.e.*, that for so many dollars and with so many treatments, he will be cured.

The proper approach may simply be care of colds, regulation of diet or faulty habits. It may simply be reassurance that all possible is being done, or that there is no progression in deafness. Laboratory diagnostic procedures may be necessary, and each visit to clear up these matters cements the tie of doctor to patient, and permits a skilled physician to break bad news to his patient at the proper time and at the proper tempo. For example, there are many patients who realize that if a hearing aid is prescribed, there is no medical treatment known to the physician which will cure his deafness. Other patients feel the same way about lip-reading. A clumsy or too sudden recommendation of either may be a severe psychological shock which may turn the patient against these very useful aids to the hard-of-hearing. Encouragement to study lip-reading should always be directed by the physician himself, and the methods used must be worked out for the individual patient. This is just as legitimate a medical service as the prescription of a drug or the instigation of mechanical manipulation or surgery. It is not sufficient to simply tell a patient to go to the local League for the Hard-of-Hear-

ing. The personal touch that indicates that the physician understands the individual's problems is essential. He should be able to recommend a *specific* lip-reading teacher or class, and make it as easy as possible for the patient to make the proper contacts. Private lip-reading lessons which will suit the natural aptitude of the patient are usually a better introduction to lip-reading than a class. Even though it is more expensive, the patient gets so much more individual attention that the added expense often pays, especially in the beginning. We have been able to get a most satisfactory arrangement at the Medical Centre. When not teaching lip-reading, the instructor does routine audiograms. The money collected for private lessons and private audiograms pays her salary.

The otologist should help his patients select a hearing aid company, and help him in his choice of a particular type of aid. He should help in the fitting of earpieces, see that they are properly made, and be sure that there is no damage to the ear in making the impression. The physician is in a much better position to impartially judge the ethics and product of various companies than is the patient. Thorough knowledge of the hearing aid field is part of the job of every good otologist, and is often neglected. It is not enough to recommend two or three reputable hearing aid companies and then let the patient choose an aid for himself.

The great difficulty in studying any treatment for deafness is in the evaluation of testing methods. Most heralded "cures for deafness" are obviously mistakes in recording the improvement. *Theoretically*, an improvement of 10 decibels for the speech range is significant. It should make the patient hear three times as far. Theoretically, an improvement of 10 decibels in the two notes, 1,024 and 2,048, should be significant, for 80 per cent of speech intelligibility is controlled in this frequency range.^{1,2} *Practically*, however, an improvement of only 10 decibels in threshold audiograms is rarely significant because routine tests are usually not taken under ideal conditions. They are often not taken in soundproofed rooms; as the patient's familiarity with the method increases, better and better audiograms are recorded, etc. It is safer, therefore, to question any improvement in hearing of less than 15 decibels unless one can be sure, from the study of multiple audiograms and averages for the speech range, that the

improvement is not due to faulty technique in testing. Voice, whisper and tuning fork tests are even more subject to outside influences than is an audiometer in a soundproofed room, and are impossible to evaluate as quantitative tests as ordinarily done.³ As mentioned before, one cannot rely upon the patient's own statements nor those of his friends. Somehow, no matter what is done, the majority of patients seem to hear better for a time after each new treatment is started. They want to hear better and they listen better. This effect is illustrated by an analogy in an experiment which many of you must have read in the February, 1941, issue of the *Reader's Digest*: "What Makes the Worker Like to Work," by Stuart Chase. The article points out that if a group of workers is selected for an experiment in efficiency, the work will improve if conditions are improved, but a selected control group will also show improvement in their work. From this it is deduced that workers work better if a little interest is shown in them. Similarly, patients feel better and think they are better if a little interest is shown in them. It is impossible to fully evaluate the subjective symptoms of a patient, and yet *the average doctor evaluates the efficacy of treatment by asking the patient if he feels or hears better*. It is not easy to stop a treatment if a patient is sure that it is making him better and is willing to pay to have it continue. Wishful thinking is a powerful force, and is responsible for a large percentage of the improvements noted from most routine office practices with adult hard-of-hearing people. Unless multiple audiograms with more than 10 decibels improvement for the speech range accompany a report of successful treatments, one must always suspect wishful thinking on the part of the author.

How potent the effect of suggestion can be in the minds of the deafened is brought out by an experiment recently performed in the Medical Centre. A number of patients were receiving hypodermic injections of prostigmin, two or three times a week, and, roughly, half of them reported improvement of their tinnitus and their deafness (see Table 1). We even had one woman who gave up her hearing aid because she thought she heard so much better. We could demonstrate no objective improvement, and when the patient heard of the fenestration operation, she begged to have it performed on her. It is impossible to be sure of the subjective symptoms in this type of patient, but multiple audiograms in a sound-

proofed room showed no changes in any of them, except what might be attributed to some inaccuracy in audiometric threshold measurement (see Table 2). To check this, many of the patients were given subcutaneous injections of normal saline solution, and the percentage of improved cases was almost the same as in those receiving the drug (*cf.*, Table 3), after

TABLE 1. SUBJECTIVE RESULTS WITH PROSTIGMIN—
(82 CLINIC CASES).

	No Improvement	Improvement	Sustained	Not Sustained
First month	26 50%	26 50%	16	10
Second month	28 54%	24 46%		
Third month	33 63%	19 37%		
			<u>Worse</u>	
Over three months	10 67%	5 33%		5 10%
<u>Incomplete</u>				
Less than one month	19 95%	1 5%		
One month or over	8 80%	2 20%		

EFFECT OF PROSTIGMIN ON TINNITUS.

	No Improvement	Improvement	Sustained	Not Sustained
First month	26 67%	13 33%	8	5
Second month	21 54%	18 46%		
			<u>Incomplete</u>	
Third month	28 72%	11 28%		
Over three months	11 85%	2 15%		
			15 cases 1 case improved	

more than a year of experimentation with prostigmin, involving 90 cases in clinic and private practice. Thirteen of the patients seem to have average improvements of 10 to 15 decibels for several notes, but examination of their previous records shows that many of them have had spontaneous changes of this magnitude in previous years without treatment, and that they were either cases of conduction type deafness, which notoriously changes 10 to 20 decibels up and down without known

TABLE 2A. AUDIOMETRIC IMPROVEMENT WITH PROSTIGMIN—
(82 CLINIC CASES).

15 DCB. IMPROVEMENT.

1 Frequency	2 Frequencies	3 Frequencies	4 or More Frequencies
256—1	128—2	512—1	128—3
512—1	256—2	1024—1	256—2
	2 Cases		
1024—2		2048—1	512—3
	1 Case		
2048—1			1024—2
4096—1			2048—3
8192—3			4098—3
9 Cases			8192—2
Incomplete			3 Cases
512—1 (injections for two months)			

TABLE 2B. AUDIOMETRIC IMPROVEMENT WITH PROSTIGMIN—
(82 CLINIC CASES).

10 DCB. IMPROVEMENT.

1 Frequency	2 Frequencies	3 Frequencies	4 or More Frequencies
256—1	128—1	128—1	128—9
512—1	256—3	1024—1	256—7
1024—1	512—2	2048—1	512—9
4096—2	1024—3		1024—10
8192—2	2048—2		2048—10
	4098—2		4098—9
	8192—1		8192—5
7 Cases	8 Cases	1 Case	10 Cases

TABLE 3. EFFECT OF SALINE ON HEARING—47 CLINIC CASES.

Recorded No Improvement	Assumed No Improvement	Recorded Improvement
16 34%	22 47%	9 19%

EFFECT OF SALINE ON TINNITUS—35 CLINIC CASES.

Recorded No Improvement	Assumed No Improvement	Recorded Improvement
10 28.5%	17 48.5%	8 23%

cause, or were designated as patients who were indefinite in their responses.* A group of deafened patients without any treatment might show similar improvement. The cases treated were, for the most part, cases of nerve deafness, either pure or combined with conduction lesions. Since the action of prostigmin is said to be the mobilization of enzymes in nerves and nerve endings, thereby increasing their efficiency, it was hoped that the VIIIth nerve would be affected likewise. I am sorry that such does not seem to be the case, and so cannot make a report recommending the use of the drug, as did Davis and Rommell.⁴

Most of the 90 cases showed no untoward results except depletion of their pocketbooks from the cost of the medication. Four cases, however, had mobiliform rashes from the prostigmin bromide; two cases had diarrhea; several complained of headaches and dizziness; one had a convulsion

TABLE 4. REACTIONS TO PROSTIGMIN — 90 CASES — CLINIC AND PRIVATE PRACTICE.

Rash	5
Gas — nausea — constipation.....	3
Epigastric discomfort and distress.....	3
Diarrhea	2
Swollen abdomen (ascitis — diag.: LMD).....	1
Headache — frontal.....	1
Convulsive seizure (two minutes).....	1
Muscular twitching of side of face (two hours). Tongue thick.	
Unconscious — fell down in street.....	1
Malaise	1

immediately after the injection of half an ampule; and one developed a distended abdomen, said by a local physician to be ascites. This patient stopped the prostigmin before returning to see us, and by then her abdomen had decreased in size markedly, and we were unable to confirm the diagnosis of ascites. We found only marked distortion from gas (see Table 4).

Injections of insulin and tuberculin by my father several years ago showed results similar to the prostigmin. There was marked subjective improvement in many patients at first but no definite objective improvement. Houser, Campbell and

*The prostigmin methyl sulphate for hypodermic injection was used. Most of the patients received three injections a week. At the same time, they received one tablet t.i.d. of prostigmin bromide.

Schluterberg⁵ have reported no hearing improvement in 56 cases treated with prostigmin.

One kind of deafness that proves to yield to treatment, even in adults, is that caused by obstruction of the Eustachian tube. Contrary to general belief, there is usually more loss for the high notes than for the low. It resembles the type of deafness which can artificially be produced by stuffing the ears with cotton soaked in vaselinized paraffin (see Fig. 1). Eustachian tube deafness is usually not severe at first, and often has spontaneous remissions. Patients with a tendency to grow lymphoid tissue in or near the tubes are particularly

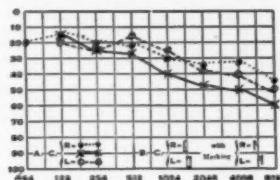


Fig. 1. Illustrates the fallacy of the popular conception that a high tone loss necessarily means a nerve deafness. The loss in these audiograms was produced by placing vaselinized-paraffin cotton plugs in the external auditory meatus.

susceptible to partial or complete blockage, and consequent low grade, nonsuppurative salpingitis, and at times otitis media. When brilliant results occur after some manipulation, one always wonders if remission might not have occurred spontaneously. I notice that my cases of this type all tend to hear better in the late summer and in the fall, when upper respiratory infections are at a minimum, and tend to relapse with their first colds.

Examination with the nasopharyngoscope is a great help. If done routinely, it is surprising how many persons will be found to have a sphenoid or posterior ethmoid condition which is draining mucopus over the orifice of the Eustachian tubes, thus shutting them off directly and, more important, causing inflammation of the lymphoid and secretory tissue in or around them.

Inflation in these cases often causes temporary relief because it dislodges secretions, but in many cases the nasal shrinkage and manipulation necessary to pass the catheter

are quite as important as the air. Insufflations of medicines, such as adrenalin, benzedrine and the like, as well as the passage of bougies, rarely produce more than a temporary alleviation of symptoms, and usually have no effect whatsoever on the cause of the trouble. There are notable exceptions, especially in acute infections.

The proper treatment for the deafness caused by infections in the nose or sinuses, and secondary infections in the nasopharynx comes with the experience and the training of the

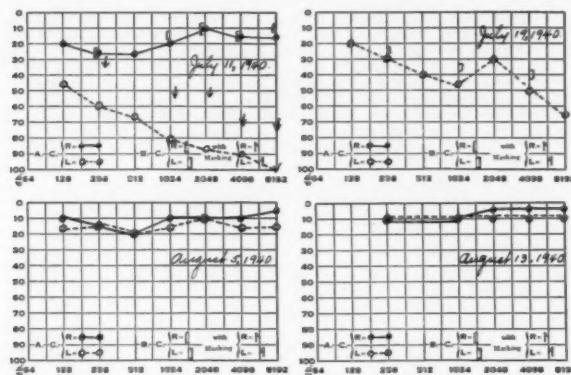


Fig. 2. Improvement in hearing following the use of ephedrine nose drops. The patient had deafness in the left ear of four months' duration with a bone conduction loss as indicated by the arrows in the first audiogram, which was so great that none of the notes could be heard with the right ear masked.

otologist administering the treatment. It varies all the way from the use of nasal shrinkage with mild ephedrine to radical surgery. It is often surprising how much benefit can be obtained from nose drops, especially if combined with swabbing or irrigation of the nasopharynx to dislodge the secretions (*cf.*, Fig. 2). It would be impossible in this paper to evaluate all the various types of sinus treatment; suffice it to say that shrinkage, suction, irrigation, Proetz' displacement, physiotherapy, radical surgery and many other measures have their place. In children, surgical removal of large adenoids is undoubtedly of paramount importance. There is a certain number of cases in which radiotherapy may be of great benefit. This is especially so when the most striking

finding is hypertrophied lymphoid tissue in or about the Eustachian tube.

The use of radium and X-ray in the treatment of deafness is not new. Sporadic reports on its use for the shrinkage of lymphoid tissue have been made for decades (Jarvis⁶). My father has a bougie containing 2 mg. of radium which 20 years ago he used to insert into the Eustachian tube for a few minutes. He had indifferent success, probably because of the small dosage. Recently, Crowe⁷ and his co-workers at Johns Hopkins selected a large number of cases with adenoid tissue about the Eustachian tubes, and with careful before and after audiograms, found that two or three treatments of approximately 2 gm. minutes of radium emanation will reduce excess lymphoid tissue without danger to the patient. They report that in a large percentage of children there was improvement of the hearing. They find the treatment much more useful in children than in adults. They feel that the use of radium emanation in the nasopharynx is more efficacious, and less dangerous than X-ray treatment from the outside. They even go so far as to suggest that it is preferable to surgical adenoidectomy in many cases, especially in very young children. The exact method employed by Crowe is not generally available. He used a capsule of radon gas containing 600 to 800 millicuries of emanation in 1 mm. of brass. No commercial company in New York will make such a capsule, and even smaller ones of 250 millicuries are too expensive at present rates for use except for the wealthiest patients. Through the efforts of Dr. A. F. Hocker, of the Memorial Hospital, I have been able to obtain the capsule containing approximately 250 millicuries of emanation, and have treated 12 private cases with it. Using this amount of emanation, it is necessary to place an instrument about the size and shape of a nasopharyngoscope into the nasopharynx for a period of about eight minutes on each side. Compared to Crowe's average of three minutes, this is a bit long, but there is some comfort in the added safety to the operator and the difference in cost. It is still a dangerous method for the operator if done very often and without careful supervision and precautions, but it certainly is an easy way to place the radiation near the part desired. The cost is not exorbitant if several cases are treated in a single sitting.

At the Medical Centre, under the direction of Dr. Lenz and his Radiotherapy Department, I have been experimenting

with the use of radium element. I find that the regular 25 mg. capsules with 0.5 mm. platinum filter, which are used most consistently by the Department of Gynecology, are only slightly larger in diameter than a nasopharyngoscope, and are no longer than the radon capsule used by Crowe. If the nasal mucosa is well shrunken, these capsules can be inserted into the nasopharynx and left there for an hour and 20 minutes, thus delivering the same dosage that is obtained by Crowe in three minutes. The capsules are available at little cost because the hospital already owns the radium and is glad to have it used. The added discomfort to the patient due to the length of time the radium stays in the nose is relatively

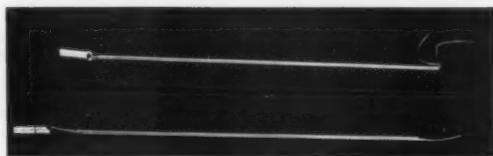


Fig. 3. Applicator for the insertion of standard 25 mg. radium capsules in the nasopharynx. The capsules have a 0.5 mm. shell of platinum with an eye at one end. A 22-gauge brass wire is threaded through the eye and pulled tight into 3/16-inch brass tubing which has been slotted at one end so that the wire will slip through without a bulge.

slight. If a child is very young, he has to be anesthetized with avertin anyhow, and he sleeps through the entire 80-minute period. Many cases throughout the country could receive the benefit of this therapy if standard radium capsules were rigged to some sort of applicator which permits their easy passage into the nasopharynx. I generally use split copper or glass tubing of 3 mm. diameter and anchor the platinum capsule containing the radium to it with brass wire (*cf.*, Fig. 3). If there are spurs on the septum, four strands of the brass wire can be used, and when they are tightly twisted they are stiff enough to push the capsule through the inferior meatus into the nasopharynx. The position of the radium can be checked by a nasopharyngeal mirror. Occasionally, when the 25 mg. capsule was not available, 10 mg. capsules were used, one above the other.

However, my largest series of radiotherapy cases has not been done with radium element or radium emanation. When the subject of radiotherapy in the nasopharynx was discussed

with Dr. Lenz and his associates (Dr. Kasabach, Dr. Eberhardt and Dr. Swenson) four years ago, it was decided that if radium emanation was effective, that X-ray therapy should also be effective, and since that time 63 persons have been treated with external radiation (see Chart 4). It has been found that dosage of 100 r. to 75 r. per sitting was the best. Treatment was given twice a week until 1,000 r. had been administered to each side.

The results with these three kinds of radiotherapy have brought out several interesting facts. In the first place, there

Date	RIGHT Air Conduction Loss										UP P.M.
	125	220	325	420	520	620	720	820	920	1020	
1/1/40	35	60	45	60	55	45	65	55	5	10	5
1/1/40											250
1/1/40	25	30	30	35	20	30	30	10	15	15	5
1/1/40											"
1/1/40	35	40	35	60	60	60	-	5	5	5	0
1/1/40								0	10	0	5
1/1/40	15	20	20	15	20	25	-	15	15	20	20
1/1/40								15	20	20	10
1/1/40	15	20	20	15	20	20	-	10	15	20	20
1/1/40								10	15	20	20
1/1/40	15	20	15	20	20	20	-	10	10	15	10
1/1/40								10	10	15	"
Bone Conduction											
1/1/40	-5	-5	15	-	-5	-5	-5	-5	-5	-5	-
1/1/40	10	0	0	-	5	5	0	-	-	-	-
1/1/40	0	-	0	-	-	1	-	0	0	-	-
1/1/40	10	0	0	10	5	-	10	0	0	10	0
1/1/40	0	5	5	20	15	-	5	0	5	15	5

Fig. 4. Improvement of hearing following the use of 1,000 r. to each side of the nasopharynx, given in dosages of 75 r. two times per week. Boy, age 8 years.

is no question that radiotherapy will often improve the patency of the Eustachian tube. We have found it efficacious, not only with lymphoid hyperplasias but also with cases having boggy Eustachian tube orifices and sticky secretions in the tubes, and patients who complain of clicking noises when they swallow, or of "stuffy ears." It works more often in children but a few adults are materially benefited. A most striking finding is the reduction of colds and recurrent otitis in the cases treated. We have not been impressed by the reduction in the lymphoid tissue *per se*, and I am inclined to believe that the main effect of the radiotherapy is the reduction of inflammation in the subepithelial tissue in the nose, with consequent reduction of secretion, and no direct destruction of lymphoid tissue by the rays. If I am right, the use of

X-ray therapy in certain of these cases (*i.e.*, those in which the infection is in the anterior sinuses rather than the posterior sinuses) would be better than local application of radon to the posterior part of the nose, as with the method of Crowe. More experience is necessary before this point is settled. Unfortunately, the use of X-ray necessitates the passage of rays through a number of structures outside the nose and nasopharynx. We have had a few cases with temporary swelling of the parotid glands and others with dry throats for two or three days. One extremely sensitive adult developed a rash and then a fine growth of hair over the irradiated

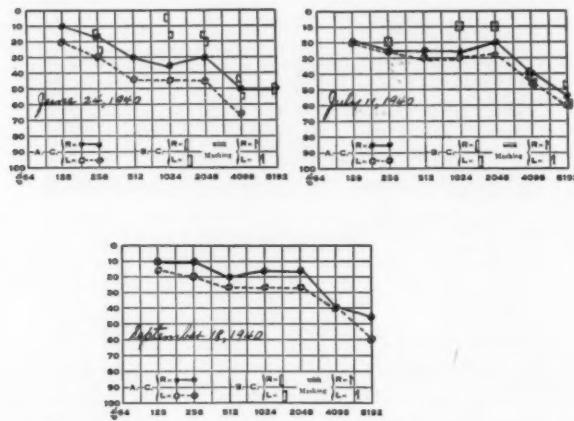


Fig. 5. Variation in hearing following use of radiotherapy in a girl, age 14 years, with a cleft palate.

skin of the neck. Untoward results can be avoided by irradiating through small ports and using different fields through which to cross-fire the nasopharynx and sinuses. Often we use an intraoral tube and irradiate through the palate. The most successful cases were those with minimal losses of not too long duration (see Fig. 4), with either a flat audiogram or audiograms in which the high notes were only 10 to 20 decb. less than the low notes, such as those described for plugging the ears with cotton (*cf.*, Figs. 1 and 5). There were a few good results with profound losses for both air and bone conduction, but cases with severe nerve type deafness, especially if there was a sharp drop or dip in the curve of hearing, tended to show no effect from the radiotherapy, even if they had much hypertrophy of lymphoid tissue about their Eustachian

chian tubes (see Fig. 6). This corresponds with the findings of Crowe and his co-workers.

I have reported on several treatments for deafness; some good, some bad. Even though the material is not new, I hope I have demonstrated that there are many things to do for a deafened patient.

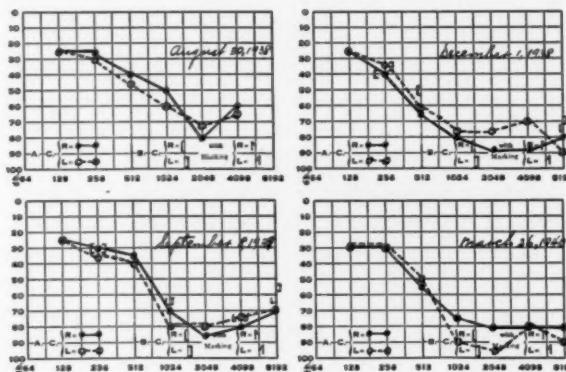


Fig. 6. Profound nerve deafness in a girl, age 10 years, whose mother has a similar audiogram. This patient had profuse growth of lymphoid tissue about her Eustachian tubes, but there was no change of hearing following 1,000 r. to each side of the nasopharynx in September, 1939.

My function has been to introduce the subject and suggest that careful quantitative tests be made, as well as to emphasize the need of a proper psychologic approach to the patient and his deafness.

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140 East 54th Street.

MICROSCOPIC STUDY OF TEMPORAL BONES IN DYSOSTOSIS MULTIPLEX (GARGOYLISM).*

DOROTHY WOLFF, Ph.D., St. Louis.

Routine collecting of human temporal bones at autopsy frequently provides rare material with opportunity for contributing unusual observations to the otological literature. Within three months' time two dwarfs of different types and etiology were autopsied by the staff of the Pathology Department of Washington University. Bilateral temporal bones were procured from each cadaver.

One of these dwarfs (see Fig. 1) was a case of dysostosis multiplex. A clinical and pathological report of the case has been presented to the medical literature of the American Medical Association by Dr. T. R. Hemplemann, Dr. E. Smith and Dr. D. P. Barr. Through the courtesy of these gentlemen I have had access to the clinical records for facts pertinent to the otological study of the case and have been introduced to the literature on the subject.

Dysostosis multiplex is a disease which has been repeatedly described since 1917 (Hunter). It has appeared under various titles, such as Hurler's syndrome, gargoyleism, Morquio's disease, etc. The clinical syndrome is that of a dwarfed individual with enlarged skull, shortened neck, limited extension of the joints, a pot-belly with splenomegaly and kyphosis. The disease, according to Hubeny and Delano, is one of interference with ossification, affecting the cartilage so that pressure changes which have occurred before the time of fusion of the epiphyses remain to contribute to the deformity. Enlarged sella turcica, hernia, blurred cornea and deafness may also occur. Wassermann is routinely negative.

I have been able to find in the 45 articles reviewed in the literature 10 cases in which deafness was recorded as a part of the syndrome. Nine of these 10 were male individuals. Normal hearing was recorded in three instances, two in male patients, one in a female. No statement in regard to auditory

*From the Oscar Johnson Institute, Department of Otolaryngology, Medical School, Washington University, St. Louis.

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acuity was found in most of the articles; however, in that of Meyer and Okner a detailed description of auditory findings was included. These were in a female child, age 9 years. The "whispered voice, R—6', L—6'; Rinne, R—, L—; Weber, R—?, L—?; bone, R—18, L—18; air, R—7, L—6; Schwanbach, 8. *Diagnosis:* Otosclerosis (?)."

(It may be said at this point that the microscopic findings in the Washington University case showed no resemblance to otosclerosis. It is evident that the M. and O. case had a conductive type of deafness.)



Fig. 1. Dysostosis multiplex in a white male, age 28 years.

It is highly probable that deafness was more common in the reported cases than is apparent. Three additional cases were reported in which no statement in regard to acuity of hearing was made, but the patient was able to say only "mama" and "papa" or had a very small vocabulary and enunciated poorly. In 16 cases statements were made in regard to the low position of the external ear, its unusual prominence or abnormal shape. Dysostosis multiplex is apparently a familial disease, "occurring in successive generations and repeated in siblings." Some cases have given a history of consanguineous marriage. An attempt was made to correlate this item with the occurrence of deafness, but only two

instances of consanguineous marriage and deafness could be established.

The distorted barrel-shaped chest evidently hampers breathing so that these patients come to the otolaryngologist complaining of frequent colds and asthmatic breathing.

CASE HISTORY.

C. B., a white male, age 28 years, entered Barnes Hospital with dysostosis multiplex. His recorded history dates back to the time when he entered Children's Hospital at 5½ years for tonsil and adenoid operation. The onset of the dysostosis multiplex had been first noted when the child was age 3 years. A maternal great-uncle, uncle and cousin all had



Fig. 2. The claw-like hands are the result of inability to extend the fingers. The arms also cannot be straightened.

a condition similar to that of the patient (see Fig. 5). At 5½ years the boy was of average size for his age, being 92 cm. (36½ in.). From umbilicus to the top of the head he measured 43 cm. (16½ in.); from the umbilicus to the sole of the heel, 49 cm. His extremities were out of proportion to his height. The circumference of the head was 52 cm. and was described as dolicocephalic, being broader in back than in front and sloping forward and upward like a roof. The sutures were closed along the suture lines. The forehead was prominent. The nose was short and its bridge quite depressed. The eyes protruded; the lips and eyelids were thick. The hair was thin, sparse, coarse and brittle; the skin was moist. There was no adenopathy. The hands were stubby. The ears were normal. The right eye had a few black spots back of the lens; another was on the posterior lens capsule. The fundus was normal. In the left eye the disc was grayish, with blurred margins. The boy spoke with a hoarse voice which was much older than normal for his age. He had inspiratory stridor. The breath sounds were harsh and "cogwheel."

The impression at that time (1918) was that the child had hypothyroidism. In the following year he returned to the hospital with a discharging left ear and was deaf. His fingers showed clubbing and could not be fully extended. He had a slow, poky gait with a tendency to fall forward. He was always sleepy.

In 1922, he returned to the hospital because of severe nosebleed. At this time the red blood cell count was 1,750,000. A splenectomy was done.

In 1932, at the age of 19 years, the deafness had progressed and was considered to be of the inner ear type. The hands were claw-like (see Fig. 2) in appearance and inability of extension was also noted in elbow and shoulder joints.

In 1937, L. W. Dean, Sr., saw the patient and observed congenital stenosis of each external auditory canal. He stated that "the boy's hearing must have been much better at one time because he has some speech and has not had aural training." An audiometer record (see Fig. 3) was done, with the report that hearing was totally impaired for usefulness. He heard only the very loudest tones. Weber was referred to the left.

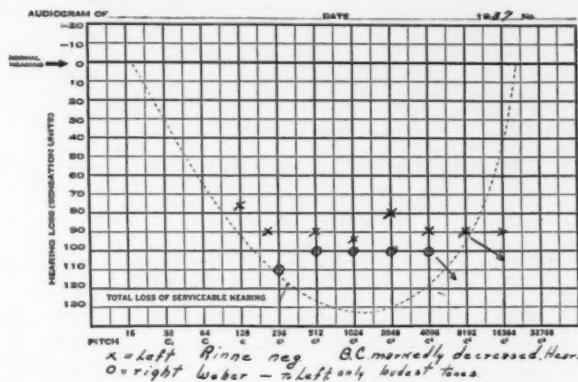


Fig. 3. Audiometer record of a case of dysostosis multiplex. Hearing totally impaired for usefulness.

Rinne was negative for both right and left. The patient died of cardiac failure in 1940.

The postmortem examination revealed the presence of a thymus which weighed 7 gm. and was microscopically that of a child. There was lymphoid exhaustion of lymph nodes, chronic endocarditis of the mitral, tricuspid and aortic valves with aneurysms of the margins of mitral and tricuspid. Liver cells were large and variable in shape. Sections of the elbow joint showed a humerus curved to an abnormal degree so that extension was limited to 60°. Microscopic examination showed normal bony structure. In the skull the calvarium was abnormally thickened, the sella turcica greatly enlarged, the external auditory canals were only about two-thirds of their normal diameter. No significant abnormality of brain tissue was observed.

MICROSCOPIC OBSERVATIONS OF THE TEMPORAL BONES.

Postmortem examinations have been made on six cases. So far as the author knows, this is the first report in the literature on temporal bones in dysostosis multiplex (Specimen No. 8768).

Both mastoid antra were abnormally small. Almost no paranasal cells were present (see Fig. 4). Relatively few bony trabeculae occurred, and those which were present were thick and blunt. The lacunae of the bone were devoid of cells. In spite of the fact that the mastoid and petrosa appeared to be of more dense bone than is commonly seen, occasional sizable

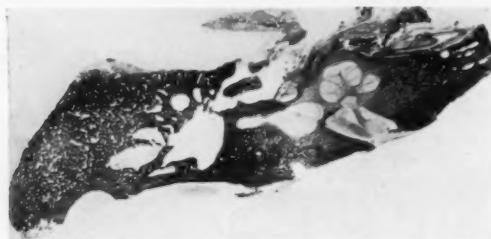


Fig. 4. Microscopic section of the temporal bone in a case of dysostosis multiplex. W.U. 8768.

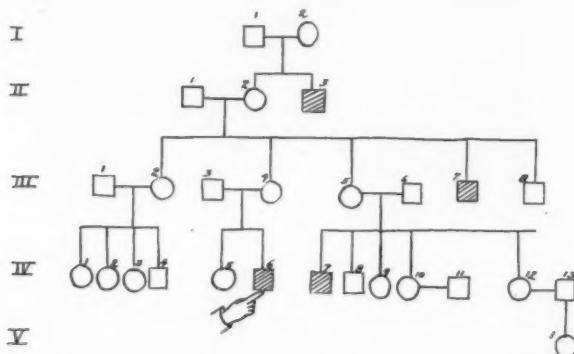


Fig. 5. Five-generation pedigree chart showing inheritance of dysostosis multiplex, IV-6 being the propositus described in this paper and illustrated in Fig. 1.

spaces were seen in the microscopic field, which had the exact contour of unusually large blood vessels. These frequently branched in the pattern of blood vessels. The general effect as seen in the photograph (see Fig. 4) was that of a porous bone. Irregular areas of dense fibrosis occurred in the bone, and deposited in the midst of this tissue appeared jagged, irregular deposits of calcium.

Shrapnell's membrane was not fully formed, and Prussak's pouch was, therefore, unusually small. Membrana tensa was

thickened. No joint cavity was seen in the malleoincudal joints. A slight amount of cellular exudate was present in the anterior part of the middle ear cavities, in the niches of round and oval windows and in the lumina of the Eustachian tubes.

Inner ears showed irregular contour of the semicircular canals. Within the round window on the left, irregular bony nodules protruded into scala tympani. Reissner's membrane was intact throughout. The spiral ligament contained large cystic spaces surrounded by areas of dense fibrosis. Stria vascularis had disintegrated. Organ of Corti preserved its normal contour but no normal cells could be identified. Rosenthal's canal was either devoid of nerve fibres or contained a few hollow strands of neurilemma sheath cells. Spiral ganglion cells stained very faintly and showed vacuolated cytoplasm. They did not show any appreciable decrease in number in the various sections.

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A CASE OF OTITIC MENINGITIS PNEUMONIC TYPE III WITH RECOVERY.*

DR. ALVIN M. STREET.

In presenting this case we offer nothing that has not been presented before; however, it has a few unique qualities which we will try to stress as we go along.

H. D., white female, age 60 years, was admitted to our service Oct. 7, 1940, being transferred from the medical service, where she was under treatment for mild diabetes.

Examination of ears, nose and throat showed a moderately profuse discharge from the right ear; left ear negative. Throat and nose, no clinical pathology. The next two weeks the ear continued to discharge. The patient when first admitted was given several doses of sulfapyridine. This did not agree with her and so was discontinued. The other treatment was the usual cleansing and boric acid-alcohol drops.

Nov. 2, a note was made that she should have a simple mastoidectomy, Nov. 4; however, Sunday, Nov. 3, at 7:00 A.M., the patient suddenly became acutely ill. Temperature 102.8°; vomiting and stiff neck appeared. Spinal tap showed fluid under increased pressure; 1,850 cells per cc., smear negative, but culture following day revealed pneumococci type III. As I was on service, I was called for consultation.

I saw the patient for the first time and requested an eye and neurological examination; all concurred in the diagnosis of fulminating meningitis with acute mastoiditis.

The patient was prepared and operated upon for a simple mastoidectomy. There was a large mastoid cavity; cells towards tip were pneumatic but about the antrum were broken down. The lateral and horizontal semicircular canals were exposed and dural plate (size of quarter) removed. There was an epidural abscess, but without the usual granulations; instead there was a discoloration about the size of one's thumb nail, and from several lacelike openings was escaping

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spinal fluid. In a very extensive surgery of this area, both actual and assisting, I had never experienced any pathology similar to this. Upon the surface appeared numerous droplets of spinal fluid and this, the following day, became a solid stream, excreting from 10 to 15 cm. daily.

Not being too sure of the lateral sinus, we opened it but there was a free flow of blood. The wound was packed with wet boric acid solution and left open. The blood pressure was 180/110, temperature 103°.

I expected to hear the next day the usual dismal prognosis but, on the other hand, her temperature had come down to 100°. Fluid was now flowing freely; a dressing consisting of a rubber drain was inserted to midfossae area and left there. Her condition was encouraging. Spinal tap shows 750 cells; the culture from yesterday came back type III pneumococci. She was given 500 cc. blood transfusion. Her diabetes was being taken care of by insulin and diet.

Now comes the most important part contributing to her cure; sulfapyridine gm. 2.5 intravenously and 1 gm. by mouth was given her every four hours for eight days. At this time the patient was definitely out of the woods. There was still cloudy spinal fluid, with a count of 204. Blood sugar, 175; blood sulfapyridine, 2.9.

Eight days after the operation the sulfapyridine was reduced to 2.5 gm. every four hours, and continued for 13 days. She was now perfectly rational. Sulfapyridine at this time was further reduced to 10 gr. t.i.d. and this was continued until she was discharged 44 days after operation with complete recovery.

In conclusion: This case recovered because the site of infection was drained surgically so quickly, because she had ample sulfapyridine scientifically administered and because it was administered for such a long period after the meningitis began.

TYPE III PNEUMOCOCCUS MENINGITIS AND SEPTICEMIA WITH COMPLETE RECOVERY.*

DR. M. MOGHADER, New York.

On Feb. 13, 1940, W. K., male, age 38 years and weighing about 150 pounds, was suffering from an acute rhinitis which had been coming on for the past two days. He had no elevation of temperature and seemed to be in good general condition. There was a general inflammation of the nasal mucosa and the throat was slightly inflamed. The ears and chest were negative. Local treatment for the relief of congestion was administered, and codein, phenacetin and aspirin were prescribed.

Four days later, I was called to his home. He had had severe pain in the right ear the night before and had called in the family physician, who gave him some medicine for the relief of the pain. I found the right eardrum inflamed and the landmarks gone. There was no bulging. The temperature at that time was 101° F.

He was admitted to the Manhattan Eye, Ear and Throat Hospital at once and a myringotomy was performed. There was very little discharge from the ear during the next 24 hours; however, he began to look worse every day, showing signs of absorption. He had a slight elevation of temperature. The tongue was coated and there was some tenderness over the mastoid tip. Suspecting that this process might have been going on for a longer period than that during which he had been under my care, I advised X-ray examination of the mastoid. Dr. Law reported the right mastoid as small and cellular, with cells filled with granulations and exudate, and with considerable softening in the deeper cells overlying the sinus and between the sinus and posterior canal wall. It was also reported that the petrous bone was cellular on both sides, with some congestion in the right apex.

The following day the patient looked worse and complained of headache and lack of appetite. Four days later, mastoidectomy was advised and performed promptly.

*Read at the meeting of the New York Academy of Medicine, Section on Otolaryngology, Dec. 20, 1940.

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The cortex was thick, the cells were filled with granulations and looked hemorrhagic. The cells around the sinus walls were cleaned out, the dura and sinus were exposed surgically, and the wound was washed out and dressed. Recovery from the operation seemed to be uneventful, although once in a while during postoperative treatment the patient would complain of headaches on that side of the head. The mastoid wound was completely healed by April 1, 40 days after the operation.

Eight days later the patient suffered a very severe headache, so much so that he could not move his head. The family physician gave him some powders to relieve the pain. I saw the patient early the next morning. He had a temperature of 103° F. and was suffering from excruciating headache. He had a slight chill the night before, and there were some vague signs of meningitis on examination. He was driven to the hospital in an ambulance at once. The wound, which had completely healed, was reopened. The dura was exposed thoroughly in the temporal and middle fossae. It looked inflamed and thickened. The sinus exposure was also enlarged down to the bulb. Its wall was covered with granulations and did not look healthy. I tied the jugular vein and opened the lateral sinus, but no clot was found. There was extensive bleeding at both ends. The wound was packed with iodoform gauze and dressed. A lumbar puncture was performed on the table. Twenty-four hours later the dura was nicked one-quarter of an inch at half-inch intervals at several points in the middle fossa. The foot of the bed was elevated to enhance drainage of the spinal fluid. During the next 24 hours the patient suffered with headaches even more severe than before operation, holding his hands to his head and trying to keep the light out of his eyes. Soon after that he became very violent, went into a state of semiconsciousness and had to be restrained. He was delirious, but could move all extremities well. There was a bilateral Babinski sign; tendon reflexes on the left were much reduced; there was some neck rigidity; the Kernig sign could not be tested because of leg restraints. In order to quiet him down, 8 dr. of paraldehyde was given by rectum, in addition to 7.5 gr. of sodium amytal, which was repeated at intervals.

Eighteen hours after operation — that is, as soon as the laboratory reports were received showing the growth of type .

III pneumococcus in the cerebrospinal fluid, intensive sodium sulfapyridine treatment was instituted. The patient was given 300 gr. intravenously the first 24 hours and 150 gr. daily thereafter for the next six days. Eleven days later, intravenous injections were discontinued and the medicine was given by mouth, beginning with 100 gr. and cutting it down gradually to 45 gr. daily. It was discontinued on the eighteenth day. In these 18 days the patient received a little less than 2,000 gr. of sodium sulfapyridine, of which 1,600 gr. were given intravenously and the other 400 by mouth.

The temperature on the first postoperative day was 104.2° F. at 3:00 P.M. After two 75 gr. doses of the drug had been administered, the temperature dropped to 102°, and after the third dose it was 99.8°, and kept down thereafter. Within 48 hours the sulfapyridine concentration in the blood reached 15 mg., and in the spinal fluid, 7 mg. This rapid concentration was due to the fact that the patient was taking in very little fluids and had retention. Although the dose was not decreased after the second day, the blood concentration gradually came down to 6 mg. and then to 3 mg., and later to 0.7 mg. This was naturally due to intake of more fluids. The urine showed heavy traces of albumin with casts, and many sulfapyridine crystals while concentration was high. Soon after there was only a slight trace of albumin and occasional pus cells, the crystals disappearing. The effect of the sulfapyridine on the blood was not as bad as had been reported in the literature. The first count showed 4,750,000 red cells. Within 24 hours it dropped to 3,750,000, and stayed at that low reading all through the illness. The patient had three transfusions, two soon after operation and one 10 days later. The total amount of blood given was 1,100 cc.

The laboratory findings of the spinal fluid were as follows: The first tap, done in the operating room, showed a fluid under considerable pressure, quite turbid, with 5,000 cells, bacteria found on the smear, and the culture showing type III pneumococcus. The puncture the next day revealed still greater pressure, more turbidity, with 5,900 cells, 4+ albumin, 4+ globulin and a moderate reduction of sugar. Culture and smears both showed many pneumococci, type III. On the third day the pressure was less but there was still a growth of pneumococcus. The tap showed improvement on

the fifth day, and on the sixth we got clear fluid, with no organisms found on the smear, and no growth; however, there were still some 200 cells. The first blood culture taken showed a growth of type III pneumococcus after 36 hours, but later cultures were all negative.

A word about the toxicity and complications of sodium sulfapyridine. There were no severe complications in this case; the only ones noticed were those in the first two days while the concentration was high, or should we say, while the meningitis was active? They were: 1. vomiting; 2. aneuria; 3. irritability and confusion. There were very few gastric complications, no hematemesis, no cutaneous lesions, slight anemia, no cyanosis, jaundice, diarrhea, lethargy or dyspnea.

CONCLUSIONS.

Although many similar cases have been treated with sodium sulfapyridine with failure, the result in this case, in my opinion, was due: 1. to the prompt and rapid elimination of the focus of infection, with the tying of the internal jugular and nicking of the dura in the middle fossa to enhance drainage of the cerebrospinal fluid; 2. the early, fearless and rapid concentration of the drug in the blood and the spinal fluid, and its maintenance for a considerable period (18 days) by intravenous injections of enormous doses; and 3. the very good general condition of the patient, allowing him to take the sulfapyridine *blitzkrieg* without severe toxic symptoms.

WHAT IS BEING DONE FOR THE DEAFNESS OF SCHOOL CHILDREN.*

DR. WESTLEY M. HUNT, New York.

About two years ago the President of the Board of Education of New York, in co-operation with the New York Academy of Medicine, appointed a committee to study the question of the acoustically handicapped of the public schools of the city of New York. This committee consisted of Dr. Edmund P. Fowler, Sr., Chairman; Clarence D. O'Connor, Superintendent of the Lexington School for the Deaf in New York; Miss Estelle Samuelson, Executive Secretary of the New York League for the Hard-of-Hearing; Prof. Robert Rock, Professor of Psychology, Fordham University; and myself.

In making this study, the committee had the close co-operation of Mr. Harold A. McCormick, of the Board of Education, and the advice, thought and interest of many particularly qualified persons from this city and other cities who had intimate knowledge of facilities, provisions and needs of the acoustically handicapped.

The committee undertook:

1. Studies of the incidence on the basis of group audiometer tests.
2. Studies of incidence for educational and medical purposes on the basis of pitch tone audiometer tests.
3. Studies of otological needs through actual otological examinations by a committee of otologists.
4. A detailed study of hearing tests, otological findings and case records of P.S. 47, New York (school for deaf and hard-of-hearing children), including otological examinations of a sample of approximately 50 children, and a pitch tone test of every school child.

*Read at the meeting of the New York Academy of Medicine, Section on Otolaryngology, Feb. 19, 1941.

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5. A study of the unofficial compensatory educational program provided for the hard-of-hearing children in the schools throughout the city under the sponsorship of the Board of Education, operated by the W.P.A.

6. Studies of speech, educational achievement, personality and emotional adjustments of acoustically handicapped children, either deaf or hard-of-hearing.

7. A follow-up of graduates of P.S. 47, Manhattan, through questionnaires and visits to homes, high schools and vocational schools.

8. A study of equipment available and used for listing hearing and for acoustic and auricular training.

The data for this study were obtained by reports and recommendations furnished by the Board of Education, an extensive survey by means of questionnaires sent to the school for information as to records, disposition of cases, equipment, etc., together with thousands of audiograms and otological examinations. Included in this study are the opinions of experts on child psychology, intelligence ratings, teaching of the deaf and hard-of-hearing, seating and lighting of school rooms, the number, make, age and accuracy of all audiometers in use, unit hearing aids, individual hearing aids, amplification in classrooms, and transportation to and from special school for the deaf and hard-of-hearing.

This study, which took over two years to complete, with its findings and recommendations, will soon be made available.

The committee feels it has furnished convincing evidence of the extent of the problem not only in New York but also in other cities. It stresses particularly the necessity of preventive treatment, diagnosis, prognosis, extent of hearing loss, general educational success or failure, personality and emotional adjustment of the acoustically handicapped in our public schools.

In this study the committee, with the co-operation of the W.P.A. Lip-Reading Project, administered the group (4A) audiometer test to 30,592 children. Sixteen schools were selected at random with the object of obtaining a fair sampling of the various grade levels.

No. and Kind of Schools Tested	No. Tested with 4A Audiometer	No. with Impaired Hearing in One and Two Ears, and Percentages		
		Totals	1 Ear	2 Ears
5 Elementary	5,657	772—13%	470—8%	302—5%
5 Junior High	6,649	665—10%	409—6%	256—4%
2 High Schools.....	10,843	539— 5%	395—4%	144—1%
4 Vocational	7,443	570— 8%	397—6%	173—2%
		2,546	1,671	875

Eight hundred seventy-five cases of impaired hearing in both ears in this study show an incidence of 2.9 per cent.

Of the 2,546 cases, 1,224 with a loss in one or both ears were given the 2A or 6A individual audiometer test; and of these cases, 1,080 submitted to an otological examination.

	2A or 6A Tests	Otological Exam.
Elementary	337	312
Junior High.....	386	352
High School.....	256	219
Vocational High.....	245	197
	1,224	1,080

In order to study the sampling of the 1,080 cases which have had a complete otological examination, the following break-downs were made: 1. On the basis of method of teaching and seating in the classroom. 2. The otologic diagnosis and contributing factors in etiology.

The 1,080 cases were classified as follows, to determine which group needed: 1. Lip-reading. 2. Lip-reading plus special training or coaching. 3. Lip-reading plus hearing aid and perhaps special coaching. 4. Special cases needing special hearing equipment and special teaching. 5. Special seating and lighting arrangement.

This was done by dividing them into six groups: 1. Hearing loss of 20-59 decb. in the better ear. 2. Hearing loss of 60 decb. or more in both ears. 3. Hearing loss between 15 decb. and 19 decb. in both ears (less than 20 decb.). 4. Hearing loss of 15 decb. to 20 decb. in better ear, but 20 decb. to 60 decb. in worse ear. 5. Hearing loss of 10 decb. to 14 decb. in better ear, but 10 decb. to 60 decb. in worse ear.

In the tables which follow, *suppurative chronic otitis media* indicates a discharging ear or ears at the time of examination, and includes recurrent cases.

Suppurative healed otitis media indicates recurrent and residual adhesive cases not discharging at the time of examination.

Nonsuppurative healed (often called catarrhal otitis media) indicates recurrent and chronic nonsuppurative cases.

Cerumen indicates either impacted or so profuse as to prevent examination of eardrum without treatment. (Examining otologists gave no treatment.)

The heading *T. A.* indicates hypertrophied or diseased tonsils or adenoids, or both.

Sinus indicates the presence of sinusitis.

Turb. indicates some abnormal condition of the turbinates.

L. T. indicates the presence of excessive pharyngeal lymph tissue.

Sept. indicates some deflection of the nasal septum causing obstruction.

Only one diagnosis is given for the ears, nose and throat, although the majority of the cases had two or more conditions in the ears (mixed deafness, suppurative healed in one ear, and nonsuppurative in the other ear, etc.), together with one or more pathological conditions in the nose and throat.

A great many of the cases were so-called "past masked," which means that the pathological conditions of the ears were not noted by the child or parent, being first discovered by the examining otologist.

BREAK-DOWN OF 1,080 CASES.

ELEMENTARY SCHOOLS—312 CASES EXAMINED.

Hearing loss—20 decb. to 59 decb. in the better ear.

T. A.	Sinus	Turb.	L. T.	Sept.	Total
Nerve deafness 2	3	1	1	1	8
Sup. chronic 4	2	5	3	1	15
Sup. healed 14	9	3	5	0	31
Nonsup. healed 6	4	0	1	1	12
Cerumen 3	1	0	3	0	7
Negative ear 1	0	0	0	0	1 74
Hearing loss—60 decb. or more in both ears.					
Nerve Deafness 2	1	0	0	0	3
Sup. healed 0	0	0	1	0	1 4
Hearing loss—between 15 decb. and 19 decb. in both ears (less than 20 decb.).					
Sup. healed 1	1	1	2	0	5
Nonsup. healed 4	1	1	2	0	8
Cerumen 0	1	0	1	0	2 15

Hearing loss—15 deb. to 20 deb. in better ear, but 20 deb. to 60 deb. in worse ear.

Nerve deafness	1	0	0	1	0	2
Sup. chronic	1	2	3	2	2	8
Sup. healed	10	6	4	4	0	24
Nonsup. healed	4	1	1	2	0	8
Cerumen	2	1	2	0	0	5 47

Hearing loss—10 deb. to 14 deb. in better ear, but 10 deb. to 60 deb. in worse ear.

Nerve deafness	0	0	1	0	1	2
Sup. chronic	1	1	1	1	0	4
Sup. healed	11	7	4	10	0	32
Nonsup. healed	28	3	6	4	1	42
Cerumen	2	2	0	1	0	5
Negative ear	—	—	—	1	—	1 86

Hearing loss—1 deb. to 5 deb. in better ear, but 5 deb. to 60 deb. loss in worse ear.

Acute otitis M.	3	0	0	0	0	3
Nerve deafness	2	1	1	4	0	8
Sup. chronic	1	3	0	0	0	4
Sup. healed	10	8	3	5	0	26
Nonsup. healed	19	7	5	11	0	42
Cerumen	—	—	—	—	—	10
Cerumen	2	0	1	0	0	3
Negative ears	—	—	—	—	—	1 97

JUNIOR HIGH SCHOOL—352 CASES.

Hearing loss—20 deb. to 50 deb. in the better ear.

	T. A.	Sinus	Turb.	L. T.	Sept.	Total
Nerve deafness	1	3	2	1	0	7
Sup. chronic	5	2	6	3	0	16
Sup. healed	18	10	5	5	0	38
Nonsup. healed	7	4	2	2	0	15
Cerumen	1	1	0	0	0	2 78

Hearing loss—60 deb. or more in both ears.

Hearing loss—between 15 deb. and 19 deb. in both ears (less than 20 deb.).

Sup. chronic	0	0	0	1	0	1
Sup. healed	2	1	3	3	0	9
Nonsup. healed	5	1	1	0	0	7
Cerumen	1	1	1	2	0	5 22

Hearing loss—15 deb. to 20 deb. in better ear, but 20 deb. to 60 deb. in worse ear.

Sup. chronic	1	0	3	3	0	7
Sup. healed	5	3	4	2	0	14
Nonsup. healed	5	2	3	2	0	12
Cerumen	0	1	1	0	0	2 35

Hearing loss—10 deb. to 14 deb. in better ear, but 10 deb. to 60 deb. in worse ear.

Nerve deafness	0	0	1	1	1	2
Sup. chronic	2	0	2	0	0	4
Sup. healed	14	6	6	5	0	31
Nonsup. healed	20	6	9	7	0	42
Cerumen	1	0	1	0	0	2 81

Hearing loss—1 dcb. to 5 dcb. in better ear, but 5 dcb. to 60 dcb. in worse ear.

Nerve deafness	1	0	0	1	0	2
Sup. chronic	2	0	1	1	0	4
Sup. healed	12	5	7	5	0	29
Nonsup. healed	26	5	8	23	3	65
Cerumen	—	—	—	—	—	14
Cerumen	3	0	3	0	0	6 120

HIGH SCHOOLS—219 CASES.

T. A.	Sinus	Turb.	L. T.	Sept.	Total
Nerve deafness	3	1	2	1	7
Sup. chronic	4	8	3	4	19
Sup. healed	12	9	7	2	30
Nonsup. healed	5	4	5	2	16
Cerumen	1	0	1	0	2 74

Hearing loss—60 dcb. or more in both ears.

Nerve deafness	2	1	0	0	0	3
Sup. healed	1	0	0	0	0	1 4

Hearing loss—between 15 dcb. and 19 dcb. in both ears (less than 20 dcb.).

Sup. chronic	1	0	0	0	0	1
Sup. healed	3	1	0	0	0	4
Nonsup. healed	1	1	1	1	0	4
Cerumen	1	1	0	2	0	4 13

Hearing loss—15 dcb. to 20 dcb. in better ear, but 20 dcb. to 60 dcb. in worse ear.

Nerve deafness	2	0	0	1	0	3
Sup. chronic	2	1	1	2	0	6
Sup. healed	6	1	3	1	1	12
Nonsup. healed	3	2	0	2	1	8
Cerumen	0	1	0	1	0	2 31

Hearing loss—10 dcb. to 14 dcb. in better ear, but 10 dcb. to 60 dcb. in worse ear.

Nerve deafness	1	0	0	1	0	2
Sup. chronic	0	1	0	0	0	1
Sup. healed	6	4	5	6	1	22
Nonsup. healed	12	2	4	3	0	21
Cerumen	1	1	0	1	0	3 49

Hearing loss—1 dcb. to 5 dcb. in better ear, but 5 dcb. to 60 dcb. in worse ear.

Sup. chronic	2	2	0	3	0	7
Sup. healed	13	5	2	6	0	26
Nonsup. healed	18	4	3	7	1	33
Cerumen	3	0	0	1	1	5
Negative ears	3	1	0	0	0	4 75

VOCATIONAL SCHOOLS—197 CASES.

Hearing loss—20 dcb. to 59 dcb. in better ear.

T. A.	Sinus	Turb.	L. T.	Sept.	Total
Nerve deafness	1	0	0	1	0
Sup. chronic	3	8	3	3	1
Sup. healed	10	7	6	1	0
Nonsup. healed	5	5	3	2	2
Cerumen	1	0	0	0	1 62

(No 60 dcb. or more in both ears.)

Hearing loss—between 15 deb. and 19 deb. in both ears (less than 20 deb.).						
Sup. chronic	0	0	1	0	0	1
Sup. healed	2	0	0	0	0	2
Nonsup. healed	2	0	1	3	0	6 9
Hearing loss—15 deb. to 20 deb. in better ear, but 20 deb. to 60 deb. in worse ear.						
Sup. chronic	1	0	0	1	0	2
Sup. healed	4	2	2	3	0	11
Nonsup. healed	2	1	2	1	0	6
Cerumen	1	0	0	0	0	1 20
Hearing loss—10 deb. to 14 deb. in better ear, but 10 deb. to 60 deb. in worse ear.						
Nerve deafness	0	1	1	1	0	3
Sup. chronic	1	1	0	1	0	3
Sup. healed	5	4	2	3	0	14
Nonsup. healed	7	1	1	2	1	12 32
Hearing loss—1 deb. to 5 deb. in better ear, but 5 deb. to 60 deb. in worse ear.						
Sup. chronic	1	1	1	1	0	4
Sup. healed	7	3	3	2	0	15
Nonsup. healed	12	0	2	4	0	18
Cerumen	3	0	0	0	0	3 40
Cerumen	0	0	0	0	0	12 12

Break-down of four charts of the elementary, junior high, high and vocational schools:

	El.	J.H.	H.	Vo.	Total	
(1)	74	78	74	62	288	20-59 deb. in better ear.
(2)	4	0	4	0	8	60 deb. or more in both ears.
(3)	15	22	13	9	59	15-19 deb. in both ears (less than 20 deb.)
(4)	47	35	31	20	133	15-20 deb. in better ear, 20 to 60 deb. in worse ear.
(5)	86	81	49	32	248	10-14 deb. in better ear, 10-60 dc. in worse ear.
(6)	97	120	75	52	344	1-5 deb. in better ear, 5-60 deb. in worse ear.

It is apparent that the number of cases in each of these six cases is fairly constant in each school grade.

Groups 1, 5 and 6 have the larger number; *i.e.*, those who have a hearing loss of 20-59 deb. in the better ear; 10-14 deb. in the better ear, and 10-60 deb. in the worse ear; and 1-4 deb. in the better ear, and 5-60 deb. in the worse ear.

The number of very deaf, *i.e.*, 60 deb. or more in both ears, and those of a hearing loss of less than 20 deb., are comparatively few.

Those of 60 deb. or more in both ears are probably in schools for the deaf.

This leaves a large group who, in order to make the most of their hearing facilities, must have special consideration in the classroom — methods of teaching and aid to hearing.

THE OTOLOGICAL DIAGNOSIS AND CONTRIBUTING FACTORS IN
ETIOLOGY.
IN THE ELEMENTARY SCHOOLS THE 312 CASES EXAMINED
BREAK DOWN AS FOLLOWS:

	Total	T. A.	Sinus	Turb.	L. T.	Sept.
Nerve deafness	23	7	5	3	6	2
Sup. Chronic	31	7	8	9	6	1
Sup. healed	119	46	31	15	27	0
Nonsup. healed	112	58	16	13	21	2
Acute otitis media	3	3	0	0	0	0
Negative ear	3	1	0	0	1	0
Cerumen	36	9	3	3	5	0

THE JUNIOR HIGH SCHOOL—352 CASES.

	Total	T. A.	Sinus	Turb.	L. T.	Sept.
Nerve deafness	11	2	3	3	3	0
Sup. chronic.	32	10	2	12	8	0
Sup. healed	121	64	25	22	20	0
Nonsup. healed	141	63	18	23	16	3
Otitis media acute	0	0	0	0	0	0
Cerumen	31	6	3	6	2	0

HIGH SCHOOLS—219 CASES.

	Total	T. A.	Sinus	Turb.	L. T.	Sept.
Nerve deafness	15	8	2	2	3	0
Sup. chronic	34	9	12	4	9	0
Sup. healed	95	41	20	19	15	2
Nonsup. healed	82	39	13	13	15	2
Cerumen	16	5	3	1	4	1
Negative ears	4	3	1	0	0	0

VOCATIONAL SCHOOLS—197 CASES.

	Total	T. A.	Sinus	Turb.	L. T.	Sept.
Nerve deafness	5	1	1	1	2	0
Sup. chronic	28	6	10	5	6	0
Sup. healed	66	28	16	18	9	0
Nonsup. healed	59	26	10	9	12	3
Cerumen	17	6	0	0	0	0

THE 1,080 OTOLOGICAL EXAMINATIONS IN THE ELEMENTARY,
JUNIOR HIGH, HIGH AND VOCATIONAL SCHOOLS
BREAK DOWN AS FOLLOWS:

	Total	T. A.	Sinus	Turb.	L. T.	Sept.
Nerve deafness	54	25	11	9	14	2
Sup. chronic	125	32	32	30	29	1
Sup. healed	401	169	92	74	71	2
Nonsup. healed	394	146	54	66	64	10
Cerumen	100	26	9	10	11	0
Acute otitis media	3	3	0	0	0	0
Negative ears	7	4	1	0	1	0
Total	405	199	189	190	15	

This break-down indicates the otological diagnosis in numerical order of findings to be as follows:

1. Suppurative healed otitis, 401 cases; *i.e.*, recurrent and residual adhesive cases not discharging at the time of examination.
2. Nonsuppurative healed otitis, 394 cases; often called catarrhal otitis media, recurrent and chronic nonsuppurative cases.
3. Suppurative chronic otitis, 125 cases; a discharging ear or ears at the time of examination, including recurrent cases.
4. Nerve deafness, 54 cases; noticeable for the comparatively small number.

Factors contributing to the etiology of the otological condition are as follows:

1. Presence of hypertrophied or diseased tonsils or adenoids, or both, 405 cases.
2. Sinus infection, 199 cases.
3. Lymph tissue, 190 cases.
4. Turbinate pathology, 189 cases.
5. Deviated obstructing septa, 15 cases.

This study indicates that there is a very definite problem in the adaptation of the acoustically handicapped pupils to their physical teaching surroundings, the method of teaching approach, and physical aid for their handicap.

The otological break-down with reference to this phase of the study indicates the importance of otological examination in the solution of this problem.

The otological and etiological break-down indicates that there is a real problem in preventive deafness in our public schools.

FRONTAL SINUSITIS; OSTEOMYELITIS AND MENINGITIS; OPERATION; RECOVERY.*

DR. J. SWIFT HANLEY, New York.

This is the case of a boy, age 14 years, who was admitted to Bellevue Hospital on July 15, 1938, by ambulance. His chief complaint was headache of three days' duration, and his history on admission stated that he had not been well for the past month. He had had a head cold, chiefly localized in the nose, with stuffiness and mouth-breathing. There had been no sore throats, chills or fever. Three days previously he had had a headache for the first time. This was a severe, dull ache, fairly well localized over the right frontal sinus. It was worse when lying down and upon arising in the morning. The patient had a fever, with no chills, nausea or vomiting. He sees double occasionally when staring too long at something.

The past history showed diphtheria, measles and frequent head colds. He had had a tonsillectomy and adenoidectomy and a left mastoidectomy years before.

Physical examination on admission was negative, outside of the ear, nose and throat condition, which revealed the following:

The patient appeared acutely ill, and was rational, with a temperature of 103.6°. The pharynx was injected and a profuse purulent postnasal discharge was present. The nasal mucosa was markedly injected on the right, and pus was seen pouring from the region of the right nasofrontal duct. The nasal septum was markedly deviated to the right high up. Exquisite tenderness was present over the right frontal sinus. There was some periosteal thickening of the floor of the right frontal sinus. There was puffiness of the upper lid, and the eye was partially closed.

*Read at the meeting of the New York Academy of Medicine, Section on Otolaryngology, Jan. 15, 1941.

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Radiographic examination showed moderately cloudy right frontal and right ethmoid sinuses. The right antrum was markedly cloudy, due mainly to hypertrophic mucosa and pus in the antrum.

The right antrum was irrigated daily through the inferior meatus and there was a 4+ return of foul, broken down pus. At the same time the region of the right nasofrontal duct was well shrunk down. One week after admission, his local condition seemed improved. There was a moderate amount of generalized headache, but more over the right frontal area. There was no edema and very slight tenderness over the right frontal sinus. In spite of this, he was running a septic temperature, which ranged at different times from a low of 98° to a high of 106.5°. Every rise was preceded by a chill.

Two blood cultures, one on the eighteenth and the other on the twenty-first, showed no growth. Blood count on admission was: W.B.C., 11,550; R.B.C., 6,000,000; polymorphonuclear leucocytes, 75 per cent; hemoglobin, 100 per cent. Two hundred ten grains of sulfanilamide were administered in the seven days, and the blood count then was: W.B.C., 6,000; R.B.C., 3,500,000; polymorphonuclear leucocytes, 68 per cent; hemoglobin, 80 per cent. The patient was cyanotic at this time.

On July 23, 1938, eight days after admission, the patient had rigidity of the neck and a positive Kernig sign. The spinal fluid showed 100 cells; polys., 72; lymphocytes, 28; and sugar present. Culture in 24 hours showed: 1. Gram positive bacilli; 2. Gram negative bacilli; 3. streptococci.

A right radical frontal operation was performed on July 23, 1938. When the cortex was removed, a large amount of thick, greenish-yellow, foul pus poured out. There was no dehiscence of the inner table seen, but when the outer table at the superior part of the frontal was being taken down to the level of the inner table, pus poured out from the bone itself. The supraorbital incision was extended up to the midline of the forehead for a distance of 5 cm. The inner table and the bone above the sinus itself was removed to an extent that we thought we were beyond the disease. There was a large amount of epidural free pus. The dura itself was grayish-black in color. The wound was packed with iodoform gauze and left wide open.

The day following operation the temperature was 102°, the spinal fluid showed 700 cells with 74 per cent polys., and his general condition was good. For the next 13 days his temperature ranged from a low of 99° to a high of 102.5°. The spinal fluid cleared and no other cultures showed any growth. The wound was very dirty, and Dakin's solution was used. Culture from the sinus at operation showed a streptococcus and fusiform bacilli. On Aug. 5, 1938, a large doughy mass appeared under the scalp on the right side, extending from the operative wound to the vertex. We then knew we had not gone beyond the disease at the first operation, and decided to remove more of the cranial vault.

Second Operation: The midline incision was extended to the vertex and then carried laterally to a point just above the mastoid process. The periosteum and soft parts over this area were all necrotic and filled with foul pus. All necrotic bone was removed from this area and healthy-appearing bone was removed backwards for about 5 cm. There was a necrotic ridge of dura measuring 3 cm. x 3 cm. just above the supraorbital ridge, and a brain abscess was suspected. The dura was incised and the frontal lobe was explored with a needle, but no pus was obtained. The scalp was turned back and the wound was left open.

Following the second operation the temperature ranged around 99°. The wound was extremely dirty and the dura was covered with heavy granulations and pustules which had to be cut away, until Nov. 1, 1938. Numerous small sequestra were removed from the left frontal bone along the midline up to this date also. Sulfanilamide gr. 5 was administered every four hours until Aug. 27, when it was stopped. From July 22 to Aug. 13 he received eight transfusions, each of 500 cc. of citrated blood.

He was discharged from the hospital, Dec. 3, 1938, when the wound was clean and had begun to epidermatize. The scalp was allowed to remain folded back.

On Nov. 12, 1939, he was admitted for a plastic operation, which was done. At the present time there is almost complete regeneration of the skull defect.

ALLERGY IN OTOLARYNGOLOGY AND OPHTHALMOLOGY. A REVIEW OF THE RECENT CURRENT LITERATURE.

DR. FRENCH K. HANSEL, St. Louis.

During the year of 1941 comparatively few articles in the literature have been directed to the subject of allergy as related to otolaryngology and ophthalmology. In reviewing the papers presented during the past five or six years, however, one is impressed with the fact that allergy may play a part in almost any structure in this special field. In other words, manifestations of allergy may give rise to symptoms referable to the external ear, the Eustachian tube, middle and internal ears; the parotid and other salivary glands, the nose and paranasal sinuses; the mouth, pharynx, esophagus, larynx and tracheobronchial tree. More recent observations have emphasized the possible part played by allergy in Ménière's disease.

PATHOLOGY.

In a study based on the examination of 150 specimens taken from the otolaryngologic registry of the American Academy of Ophthalmology and Otolaryngology at the Army Medical Museum, Washington, D. C., Ash¹ was able to divide the cases of sinusitis represented into the following groups: Infections, 75; allergic, 28; and mixed, 47. A general summary reveals the scarcity of evidence of any suppurative process in the specimens examined as suggested by the infrequency of polymorphonuclear leucocytes, the prominence in chronic sinusitis of reticulum in the stroma and the basement membrane, the frequent appearance of lymphatic nodes and the development of superficial pseudo-glands that may become cysts or abscesses. The last named were observed in 37 specimens. The series shows that hyperplastic changes were observed more frequently than any other pathologic changes in sinusitis of the infectious type, and polyps most frequently in cases of the allergic type.

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ALLERGY OF THE NOSE AND PARANASAL SINUSES.

In his studies of the significance of the pH of nasal secretions *in situ*, Fabricant² suggests that every nasal vasoconstrictor prescribed by physicians and sold to the public should satisfy two basic physiologic requirements: 1. it should restore and maintain normal ciliary activity; and 2. it should be slightly acid with a pH value in the normal pH range of the nasal secretions *in situ*; that is, between 5.5 and 6.5. To emphasize the ciliary factor apart from the pH factor is to tell but half the story of applied nasal physiology.

In a study of the effect of silver preparations and antisepsics on the pH of nasal secretions *in situ*, Fabricant³ found that preparations which either enhance or perpetuate the alkalinity of the nasal secretions found in acute rhinitis and acute rhinosinusitis prolong an undesirable nasal status—an alkaline status, in which the bacteria producing the acute inflammation find a fertile field for growth. It is suggested that during these acute processes the employment of a silver preparation which lowers the pH to a level of 5.5 to 6.5 is most desirable. Because of their inherently alkaline composition, metaphen 1:2,500 and 1:500, merthiolate 1:1,000 and 1:5,000, and mercurochrome 0.25 to 2 per cent, convert the normal slightly acid nasal status to an alkaline status. According to the observations of Fabricant, this is undesirable. He found that mercurresin in a dilution of 1:5 satisfies the pH standards he has advanced by having a pH value that falls within the normal pH range of nasal secretions *in situ*.

In those cases of nasal allergy in which local treatment with ephedrine solutions is employed it is particularly important that the pH of the solution be on the acid side, for in these conditions the secretion is already alkaline.

Before investigating the specific action of vasoconstrictor drugs as administered by means of a nasal spray, Sternstein⁴ believed that it is essential to evaluate the physiologic effects of certain factors, such as: *a.* air pressure; and *b.* the tonicity of a solution, on the erectile tissue response of the inferior turbinate. He found that an air pressure of approximately 15 pounds, commonly employed in nasal sprays, produces little or no erectile tissue response in an unobstructed nose.

Air pressure of the same magnitude in an obstructed nose increases both the swelling of the erectile tissue and the degree of nasal obstruction. It is further noted that tonicities of sodium chloride solution of from 0.5 to 5 per cent produced little or no response in an unobstructed nose. In an obstructed nose, isotonic and hypotonic solutions gradually increase the swelling of the erectile tissue, producing a corresponding increase of nasal obstruction. A hypertonic solution of 5 per cent decreases swelling of the turbinates and nasal obstruction.

In a series of 75 cases, Youngs⁵ evaluates the efficacy of Roentgen ray therapy for chronic sinusitis. Many of those treated, he states, were definitely known to be allergic, although no extensive studies of allergy were made. The effectiveness of the therapy normally could not be evaluated until a lapse of at least two to three months. No harmful effects were noted in any of the patients.

The best results were obtained in children, or patients under 17 years of age. Marked beneficial results were obtained in mildly allergic persons, but in the severely allergic no benefits were obtained.

In discussing the causation and treatment of vasomotor rhinitis, Stovin⁶ classifies this condition from the standpoint of diagnosis and treatment into the acute and chronic types. The acute type includes all those cases in which there is a demonstrable specific inhalant, such as hay fever and rose fever. He states that in the chronic type one is usually unable to demonstrate hypersensitivity to any specific irritating allergen. From the standpoint of general treatment he discusses such phases as psychotherapy, glandular therapy, drug therapy and diet. Under local nasal treatment he recommends zinc ionization, application of phenol, electro-coagulation, irradiation, and the injection of alcohol into the nasal ganglion.

I see no particular reason for classifying nasal allergy into acute and chronic types, for it only adds confusion to already existing classifications. As far as local treatment is concerned, such procedures as ionization and the use of escharotics offer only possible temporary relief. In general, these methods of treatment have been discarded by those who specialize in the management of these cases.

Thacker and Hauser⁷ report their observations on the use of sodium morrhuate for chronic simple, vasomotor and hypertrophic forms of rhinitis. This form of therapy is recommended in those cases of chronic nasal obstruction with engorged turbinates which have failed to respond to the usual types of therapy after two months' trial. This type of treatment is not advised for cases of definite allergy with nasal manifestations which can be controlled adequately by desensitization or removal of the allergens. Nasal obstruction and associated symptoms were relieved completely in 66 per cent of the patients. The remaining 34 per cent of the cases were entirely or considerably relieved of nasal obstruction, and their postnasal drip and headaches were definitely diminished. The number of injections of a 5 per cent solution of sodium morrhuate to produce the desired effect varied. Seventy-two and four-tenths per cent of the patients required only one or two injections in one or both inferior turbinates. The length of time this treatment will relieve the symptoms has not been ascertained. Eight months have elapsed since the first patients of the series received their last injection. So far, none of the patients has had a recurrence of nasal obstruction, and there has been no clinical evidence of any deleterious effect of the drug on the nasal mucous membrane. These investigations are to be continued for another year.

In the diagnosis of allergy of the nose and paranasal sinuses with particular attention to the atypical types, Hansel⁸ calls attention to the importance of recognizing those cases in which the symptoms are vague or fail to present the usual classical clinical picture. Particular attention is called to those cases in which the symptoms consist mostly of stuffiness and postnasal discharge with little, if any, sneezing or anterior discharge. It is further emphasized that the diagnosis may depend to a great extent upon the demonstration of eosinophiles in the secretion. Because of the low grade nature of these cases, the eosinophilia is not marked and is often difficult to demonstrate. A number of case reports are presented to illustrate the different types of atypical nasal allergy.

In view of the high incidence of allergy in chronic sinusitis, it is evident that the most satisfactory results are depend-

ent upon adequate allergic management. A recent report on allergic rhinitis in which there was co-operation between the rhinologist and the allergist was presented by Woodward and Swineford.⁹ This paper illustrates the value of such co-operation. A group of 128 cases was studied. In 61 there were no significant complications. The remaining 67 showed the following: obstruction from the septum or turbinates and chronic ethmoiditis, 25; obstruction from nasal polyps, 16; pansinusitis, nine; acute and subacute maxillary sinusitis, four; and septal or turbinal obstruction without secondary infection, four.

The opinion was expressed that in general a period of allergic management plus conservative rhinologic treatment should precede surgical intervention. In those few patients with long-standing severe asthma, bronchiectasis and physical and Roentgenological evidence of chronic sinus infection, they further state that little is to be gained by the postponement of surgical intervention. It was also emphasized that when a major surgical operation is necessary, it should be complete enough to effect a cure of the complications which necessitated it. In the group of 128 cases, major surgical procedures were carried out as follows: obstruction and secondary ethmoiditis, 25; external operations, 18.

An evaluation of the results obtained in 89 cases which were followed up were as follows: 67 were still having nasal symptoms but 58 were from 75 to 100 per cent improved; 18 were 50 per cent improved; while one reported less than 50 per cent improvement.

In discussing the symptoms of gastrointestinal origin in the ear, nose and throat, Gatewood¹⁰ calls attention to the possible association of gastrointestinal allergy and nasal allergy. Among the symptoms in the ear, nose and throat, the following were enumerated: postnasal drip, vertigo, fullness in the ears, rhinorrhea, recurring colds, cough, dryness and stuffiness of the nose, and headache. Five case reports were presented to illustrate the main points in the presentation.

The otolaryngologist not infrequently observes patients with nasal allergy who also have definite gastrointestinal symptoms from food. Sometimes the internist overlooks the

allergic nature of the gastrointestinal symptoms in these cases.

Berry¹¹ reports his more recent observations on the relation of dental infections to sinusitis. The author has published a number of very comprehensive reports on this subject and is therefore an authority on this important relationship. A number of dental Roentgenograms and case reports illustrate the importance of relationship of antrum infections to dental pathology. He points out that even in those patients with nasal allergy, dental infection may be the cause of the occurrence of more than the usual number of acute colds or a complicating infection in the antrum.

Further modifications of the nasal contact test for allergy are presented by Vaughan and Derbes.¹² This test requires the use of a mirror originally devised by Glatzel, and a quantitative test by Lieb and Mulinos. The antigen is introduced into the nose by means of an inhalator similar to the Benzedrine type. The degree of nasal obstruction is measured by the length of time required for the condensation which appears on the cold mirror to evaporate.

COLDS.

In the treatment of the common cold, Veasey¹³ recommends the use of small doses of respiratory vaccine administered by the intracutaneous method. He uses an intradermal injection of 1/60 cc. of respiratory vaccine which has been diluted to one-third the original strength. He emphasizes the importance of individualizing the dosage according to the patient's sensitivity. He describes a syndrome which he designates as the bacterial allergic rhinitis. The chief complaints consist of nasal obstruction, with thin, watery nasal secretion, with or without sneezing. The symptoms may be more or less continuous or paroxysmal with remissions. The patient appears to have a cold all the time, or frequently thinks he is getting a cold which never develops beyond a second watery secretion stage. Allergic survey fails to reveal a cause, and eosinophiles are not demonstrated in the nasal secretion. Veasey states, however, that the secretion is so watery that the cells are difficult to demonstrate. In nasal allergies of this type with watery secretion, we have found that it may be necessary to centrifuge the secretion or have the patient collect it

in a bottle so that the mucoid masses may be collected for cytologic examination. It is evident that a very definite distinction must be made between infection and allergy and that the cytologic examination may be the only means of making the distinction.

Spiesman¹⁴ reports his observations on the uses of massive doses of vitamins A and D in the prevention of the common cold. It was noted that vitamins A and D in massive doses did not produce immunity to the common cold when given separately. When massive doses of these vitamins, however, were given together, 80 per cent of the subjects showed a significant reduction in both the severity and number of colds per year. The number of colds per year dropped to three, and the average duration was five days, with but little elevation in temperature. It is not assumed that the use of vitamins in the treatment of the common infectious cold was offered as a panacea. It is emphasized that average susceptibility must be taken into consideration, as well as the emotional state of the subject as affected by any innately unstable vasomotor mechanism.

In the employment of any type of therapy in the control of the common cold it is always imperative that a distinction be made between allergy and infection. In cases of nasal allergy with superimposed acute infections, vitamin therapy is a good adjunct in treatment.

ALLERGY AND BRONCHIECTASIS.

In discussing the matter of etiology of bronchiectasis, Schenck¹⁵ states that the concept that sinus infection is primary and bronchial infection secondary is supported by experimental evidence. He discusses the various routes of infection existing between the sinuses and lungs. In a series of experiments conducted, it was shown that infectious material is readily transported from the upper to the lower respiratory tract and vice versa. Schenck finally concludes that from the practical standpoint it is obvious that the treatment of chronic suppurative disease of the lower respiratory tract is doomed to failure if it does not include the thorough treatment of sinus infection. Cure of the diseased sinuses will not always be followed by the arrest of the pulmonary lesions, and once the bronchial disease is well established, eradication of sinus infection will not arrest the disease.

Goodale¹⁶ reports his observations on the study of 150 cases of bronchiectasis observed at the pulmonary clinic of the Massachusetts General Hospital. He stated that over 90 per cent of the patients had sinusitis in some degree. In the series of cases studied it was noted that bronchiectasis had developed in one-third of the patients before the age of 10 years. They gave a history of pneumonia, pleurisy, whooping cough or bronchitis as the direct precursor of the disease. There was another group in which the patients had endured bronchiectasis and sinusitis well past middle age. A third group was considered separately, which consisted of young adults and adolescents. Among these patients radical surgery was considered on those who were considered able to stand the operation. It was stated that the infected sinus and infected chest can be considered as two separate foci of infection, which together constitute the patient's disability. Removal of infection from the one without removal of infection from the other was considered as incomplete operative procedure.

Carpenter, Kerr and McMurray¹⁷ report their observations on the treatment of 38 patients with bronchiectasis by Roentgen rays. The patients treated were divided into four groups according to the severity of the disease. The greatest improvement was seen in patients with minimal and moderate involvement. It was concluded that Roentgen irradiation was only a moderately satisfactory treatment of bronchiectasis. This type of treatment resulted in some symptomatic improvement in about 50 per cent of those in whom the disease was far advanced. Finally, this treatment is recommended as a valuable adjunct for those patients who have had little improvement from removal of the foci of infection by bronchoscopic drainage and other forms of therapy and who are not amenable to surgical treatment.

Almost none of the articles presented on the subject of bronchiectasis considers allergy as a possible etiologic factor in this disease.

In a recent unpublished presentation on the relation of allergy to bronchiectasis, Riecker,¹⁸ of the University of Michigan, stated that among 127 patients with bronchiectasis, seven had asthma, 63 nasal allergy, 19 both nasal allergy and asthma, and 38 showed no allergy. The incidence

of allergy in the entire group, therefore, was about 70 per cent. Among all patients with asthma, he found an incidence of bronchiectasis of about 3 per cent.

ALLERGY OF THE EAR.

In an evaluation of the Ménière syndrome presented by Grove,¹⁹ it is pointed out that from the reports of various observers allergy plays some part in the etiology of this disease. It frequently appears in patients with other manifestations of allergy, the withdrawal of the offending allergens will cause a cessation of the attacks, and the reintroduction of the allergen will again produce an attack. Vogel²⁰ noted that among 83 patients with the Ménière syndrome, five had hay fever, nine urticaria, and 15 nasal allergy and five asthma, an incidence of allergy of about 40 per cent. It was further stated that the localization of the trouble is not in the nerve alone because no pathologic change has ever been demonstrated there microscopically.

Headache was found by Dederding²¹ to be the most frequent extra-aural symptom, being present in 91 per cent of a series of 228 cases. It has been pointed out by a number of observers that water retention is associated with the attacks. This is manifested consequently by an increase in weight, and thereby suggests the presence of angioneurotic edema.

Atkinson²² submits a very comprehensive report of his observations on the etiology and treatment of Ménière's syndrome. He reports two patients in whom foods were the cause of symptoms. Removal of these foods resulted in cessation of the attacks. A group of patients suffering from Ménière's disease were tested with histamine. On the basis of the reaction patients were classified into histamine sensitive and histamine nonsensitive. Seven histamine sensitive patients were relieved of their attacks following a course of histamine therapy. In two patients a typical attack could be produced by the injection of an adequate amount of histamine.

Forty-nine cases of Ménière's syndrome were treated by Horton²³ by the intravenous injection of histamine and obtained prompt relief. The dosage employed was 1 mg. of histamine base (2.75 mg. of histamine diphosphate) in 250 cc.

of physiological saline solution. This was administered intravenously by the gravity method at the rate of 50 or 60 drops per minute. One and one-half hours was usually required for the treatment. Injections may be repeated on successive days. To prevent future attacks, a maintenance dose of from 0.1 to 0.2 mg. of histamine is given subcutaneously from two to four times a week.

OCULAR ALLERGY.

Thomas and Warren²⁴ present an analysis of 30 consecutive cases of allergic conjunctivitis. Results of skin tests concurred with the history of inhalant factors responsible for the eye symptoms in 14 cases. Only six of the 30 patients, or 20 per cent, had no related allergic manifestations. Satisfactory results were obtained in more than 50 per cent under allergic management. This group of cases was not selected but consisted of 30 consecutive cases of allergic conjunctivitis with no exceptions.

In experimental studies of the species specificity of the proteins of the optic lens, Markin and Kyes²⁵ found that the extreme specialization of the optic lens results in a tissue whose constituent proteins are the same in two mammalian species as widely separated as dog and beef and are, therefore, in full accord with the results obtained with the precipitation tests by Uhlenhuth, Hektoen and others. Markin and Kyes further observed that the autosensitization to lens proteins induced in the guinea pig is not noted in the pigeon.

Beetham²⁶ states that allergic cataract may be unilateral as well as bilateral. In 30 to 50 per cent of the cases, involvement is unilateral. Ten cases are described in detail. On two occasions intradermal tests with aspirated aqueous humor gave negative reactions. In two cases histologic examination of the crystalline lens showed cortical degeneration and normal capsule. It is noteworthy that all the patients had an active, long-standing eczema; two also had asthma. Seven of the patients were in the third decade. One patient was 40 years of age, and two were 4 and 16 years, respectively. Five were males, and five were females. The possible part played by infection, avitaminosis, deficiency of the endocrine glands and disturbance of the autonomic nervous system were discussed. In the opinion of Beetham, allergy appears to be the most important etiological factor.

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BOOK REVIEW.

Sinus. By Russell Clark Grove, M.D., Chief of Ear, Nose and Throat Department of the Allergy Clinic, Roosevelt Hospital, New York. One hundred eighty-four pages including Index, and eight illustrations. New York: Alfred A. Knopf, Inc. 1941. Price \$2.00.

This text, intended for the layman, is written in a clear, concise style. It fulfills a long needed means of informing the public on the recent developments in this field of otolaryngology. After a discussion of the fundamental principles of the anatomy and functions of the sinuses, the causes and types of sinus disease are clearly outlined. In the diagnosis of sinus disease, he emphasizes the importance of correlating the information derived from an analysis of symptoms, the local changes, the cytology and bacteriology of the secretions and tissues, and the X-ray findings.

In the classification of sinus disease it is pointed out that the principal types are the acute, subacute and chronic, and that a definite distinction must be made between the infections, the allergies and the combined types.

In treatment he rightfully condemns the excessive use of local treatment in the form of sprays, drops and tampons. In the management of the uncomplicated cases of nasal and sinus allergy it is explained that satisfactory results may be obtained without surgical interference. On the other hand, Grove shows that in certain selected cases of allergy with infection and in cases of pure infection good results are obtained only by some surgical procedure.

Every otolaryngologist is aware of the existing skepticism on the part of the public regarding the end-results of sinus operations. To a great extent this has been the result of the lack of or the inadequate management of existing allergic involvement.

Many otolaryngologists have not had adequate training in the diagnosis and treatment of allergy and in most instances they practice in a locality in which there is no available consultation service for allergy. Under such conditions the patient is unable to obtain adequate treatment for his sinus disease if allergy is a factor. Nevertheless, the otolaryngologist who is thus handicapped realizes the seriousness of this problem and must adopt those methods of treatment by means of which he can at least give the patient partial relief.

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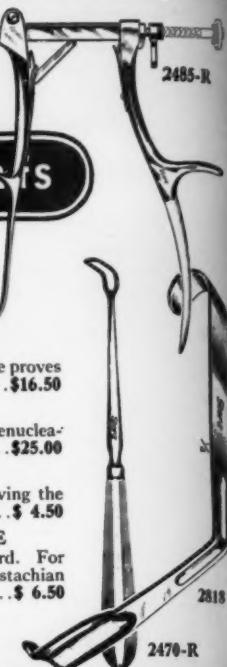
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